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Exploratory Fishing for Spanish Mackerel in Waters off Western Australia during the period June 16 to October 16, 1981

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Department of Fisheries and Wildlife

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PERTH

REPORT

No. 57

EXPLORATORY FISHING FOR SPANISH MACKEREL IN WATERS OFF WESTERN AUSTRALIA DURING THE PERIOD JUNE 16 TO OCTOBER 16, 1981

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FOREWORD

To further advance knowledge of the seasonal distribution and abundance of Spanish mackerel in the waters off the north west coast of Western Australia, it was agreed between the Commonwealth Department of Primary Industry and the Department of Fisheries and Wildlife, Western Australia that an exploratory gillnetting programme be initiated.

Information on seasonal catches of Spanish mackerel off some parts of the Western Australian coast were extracted from the Western Australian Department's register of fish catch statistics and from the analysis of these data (APPENDIX A) the decision on time span during which the programme should be carried out was decided. This period was from April to November.

The financial arrangements for costs sharing between the Department of Primary Industry and the Department of Fisheries and Wildlife were such that the Commonwealth would contribute eight thirteenths to the costs of the programme which was to be of at least 90 days duration, at an estimated cost of $130,000. Any use of the proceeds from the sale of fish caught during the vessel charter period would, subject to Ministerial approval, be used to extend the charter period if desired, or else be divided proportionally between the Commonwealth Fisheries Development Trust Account and the Fisheries Research and Development Fund of the Department of Fisheries and Wildlife of Western Australia.

A tender schedule for the charter of a suitable vessel was drawn up and duly advertised in national newspapers in April 1981. The successful tenderer was accepted in late May 1981.

The programme commenced in mid June 1981 using the chartered gill net fishing vessel "Rachel", which was manned by four persons and one or two officers from the departments of the government charterers.

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ABSTRACT

The results of catching Spanish mackerel *(Scomberomorus commerson)* by gillnet and troll lines during a survey extending from June 16 to October 16 1981 are presented.

The catch rate of mackerel obtained by trolling with six lines was found to be 14.35 times greater than that by gillnet, measuring 0.75 miles in length.

From the results presented, a professional fisherman should be able to assess the economic viability of fishing commercially for Spanish mackerel.

Analysis of biometrial and biological data on fish caught allowed determination of (a) length/weight relationship of (i) Spanish mackerel (ii) wahoo *(Acanthocybium solandri)*; (b) sex ratios of (i) Spanish mackerel (ii) wahoo; (c) gonad indices for mackerel which showed that most females during this period to be in a resting stage in the reproductive cycle.

Catch rates of Spanish mackerel related to surface temperature are shown to be highest in the temperature range 22°C to 24°C, and comparison of seasonal distribution of mackerel with seasonal positions of the 22°C and 24°C isotherms is made.

Analysis for mercury content in tissue samples from black tip shark *(Carcharhinus sorrah)* caught by gillnet indicates that the levels of mercury in the larger individuals may cause some marketing difficulties under currently recommended health regulations.

1 INTRODUCTION

This report summarises the results gained from an exploratory gillnetting cruise for Spanish Mackerel in the waters off North West Australia which was conducted from June 16 - October 16, 1981.

The itition objectives were to gillnet in areas where Spanish mackerel may occur to -

(i) assess catch rates

(ii) evaluate viability of possible operations by Australian fishermen

(iii) demonstrate, by arrangement, to interested professional fishermen the Spanish mackerel gillnet fishing methods and techniques.

Secondary objectives of the programme were to -

(i) Troll for Spanish mackerel and tuna at all opportune times to allow for comparisons to be made between catch rates obtained by both methods of fishing and obtain information on areas of greatest accumulation of mackerel.

(ii) Collect biological information relating to length, weight, sex, sexual development and stomach contents of species caught.

(iii) Record sea surface temperatures.

(iv) Sample muscle tissue from shark species taken so that methyl-mercury content could be assessed.

The charter vessel operated on a commercial basis with due regard for the objectives.

2 DESCRIPTION

2.1 CHARTER PERIOD

The charter period extended from the 16th June to the 16th October, 1981, a total of 123 days. The vessel was off charter for thirteen days during September due to mechanical breakdown. Details of fishing operations are given in Appendix C.

2.2 AREAS

The vessel commenced operations from Darwin and the area from the Western Australian/Northern Territory border to North West Cape, Western Australia was explored. Most fishing activity was concentrated in the area between Broome and Port Hedland. Wharfage (tying up and unloading) took place at Broome, Port Hedland and Dampier.

2.3 VESSEL

The 21.35 metre vessel, "Rachel", was chartered to carry out the fishing operations. This vessel had been engaged in gillnetting for Spanish mackerel in Northern Australian waters prior to charter. It

was fitted with a Decca Satellite navigator for the purposes of the survey. A description of the technical details of the vessel is given in Appendix D.

2.4 GILLNETTING OPERATIONS

A near surface fishing gillnet of 150mm stretched mesh monofilament was used with the aim of catching mackerel. The net was 0.75 nautical miles long and 100 meshes deep. An 8mm diameter lead cored "lead line" weighted the net while surface floats of 300mm diameter polystyrene attached by 3.6 metre long float lines to the head line buoyed the net (Figure 1). The depth at which the net fished could be varied by altering the length of the float lines

The gillnet was hauled and stored on a hydraulically powered net reel at the stern of the vessel. When the net was set the vessel steamed slowly downwind and the net was fed over the stern gunwale. Shark clips were used to attach the floats onto the float lines as the net was unwound from the reel. When all the net was shot, a line, attached to the net, was passed through a roller at the bow and led back to the reel so the vessel hung off the net by the bow and the net was then ready to be hauled. During the set the vessel's heading was controlled by the auto pilot and the speed from remote controls positioned at the stern. The setting operation was carried out by two people and took an average of thirty minutes to complete.

Although the vessel usually hung off the net and drifted with it, the net could be cast off and retrieved later. The duration of the set depended on the proximity of reefs and snags, the rate of drift as well as the need to avoid spoilage of the catch in warm waters and was usually less than seven hours.

The net was hauled over the bow roller then down the length of the vessel, in which distance the catch was removed, and then onto the net reel where the floats were unclipped. Floats were also removed when they came inboard over the bow roller.

Mackerel were headed and gutted as they came on board and were placed into a tank of refrigerated brine, and held there until they were further processed by freezing in the blast freezer. Fins were removed from larger sharks and bagged for sale but the carcasses were discarded.

Large sharks up to 3.2 metres were often caught in the net but little damage resulted because the net was not anchored and thus free to give so that large sharks did not mesh in the net but tended to roll it up and become entangled in a large quantity of netting.

A net designed to mesh squid was attached to the end of the gillnet. This failed to catch any squid during seven sets and its use thereafter was discontinued.

2.5 TROLLING OPERATIONS

By far the best catches of mackerel were made by trolling.

A unit of trolling gear used consisted of a 15cm 'Halco' tuna jig with a 1.5 metre trace of 'Marlin' wire, a stainless steel ball bearing swivel connected to approximately forty metres of 12mm diameter cotton 'sash cord'. Mackerel tended to fight hardest when initially hooked so a length of heavier soft lay rope (16mm diameter) was tied to the sash cord to make it easier to pull in the first few metres of the troll line. Initially rubber shock absorbers were tied to some of the troll lines to reduce break-offs and consequent loss of fish, but were dispensed with later. Pink, white, red 'Halco' lures and 'Barra spoons' were used with success but the most successful appeared to be the pink 'Halco' lure.

Several modifications were made to the jigs to enhance their longevity. The self tapping screw holding the hook to the jig was replaced with a bolt and nut. The brass ring in the leading edge of the lure was replaced with a wire trace placed through the plastic body.

With the use of outriggers as many as ten troll lines were operated at one time, with three persons tending the lines and the remaining three processing the catch.

2.6 PROCESSING AND RECOVERY

The mackerel were headed, gutted and placed in the brine tank soon after they were caught. Usually at the end of the day the fish were removed from the brine, snoods were placed around the tails and they were hung in the blast freezer until frozen, after which they were then stacked on the floor of the freezer until they were bagged for transport.

Average recovery weight from a small sample (10) of mackerel ranging in whole weight from 2.8 kg to 14 kg was determined to be 81.3% of the whole weight. From this small sample a trend in increase in recovery rate with increase in size is indicated. In this sample it ranged from 74.5% to 86.9%.

The weight of all mackerel measured and weighed, together with the estimated weight (derived by means of the length/weight relationship curve) of mackerel measured, but not weighed, was 14484 kg. The recovered weight, after processing, was 11,976.3 kg resulting in an average recovery rate of 80.7%.

3 CATCH RESULTS

3.1 GILLNETTING

The catch from 49 sets of the gillnet was 4,844 kg whole weight. Shark comprised 3,650 kg, tuna 344 kg, mackerel 356 kg and others 494 kg. The best catch from any set was 1,208 kg of shark and mackerel taken in the Bonaparte Archipelago area (Figure 2, Table 1, shot number 5). The average catch per set was 99 kg.

3.2 TROLLING

The total catch from trolling was estimated to be 17,805 kg of which 14,485 kg were Spanish mackerel. Other species of less commercial importance trolled, consisted of wahoo, trevally, Queensland school mackerel, shark mackerel and barracuda. Troll lines were towed whilst underway during daylight hours. At times as many as ten lines were trolled but on average six lines were trolled per day.

3.3 MACKEREL CATCH BY AREA BY TROLLING

The number of mackerel caught per line per hour (CPLH) was calculated for sixty nautical mile grids (Table 2). The highest CPLH of 1.05 was achieved in grid 1821 (C. Bossut area) with a total catch of 3,652 kg. From the total area fished, five sub-areas were identified as having commercial concentrations of Spanish mackerel. The catch from these areas contributed 95% to the total catch. The average CPLH for each of these areas was as follows :-

Grid 1622	Lacepede Islands to Cape Leveque	0.97 fish per line/hour
Grid 1821	Cape Bossut	1.05 fish per line/hour
Grid 1919	Bedout Islet	0.97 fish per line/hour
Grid 1915	Rankin Bank	0.31 fish per line/hour
Grid 1916	Glomar Shoals	0.96 fish per line/hour

Total line hours over all areas fished was 4,244 hours giving an average of 0.38 fish/line/hour. The highest number of hours spent in any grid was 512 hours in the vicinity of Bedout Islet (Grid 1919).

The results give some indication of the potential for trolling for Spanish mackerel in these areas. However, because of the vastness of the area surveyed and time available to carry out this survey, actual numbers should be treated cautiously when determining possible commercial operations on a long term basis.

Highest catch rates were generally associated with topographic features such as banks, shoals, and around islands. The vessel did not work in shallow waters close inshore and it is possible that the use of dories to fish these shallower areas may have yielded higher catch rates.

3.4 MACKEREL CATCH BY MONTH BY TROLLING

During the survey period the highest CPLH of 0.70 occurred during August with a catch of 9,311 kg. Analysis of catch/area/month is shown in Table 3, Figure 3. The average CPLH increased sharply from June to August, but then decreased rapidly to 0.03 in October. Again these figures should be used as a guide only because the vessel fished different areas in different months and did not continue to fish in areas of apparent highest abundance.

The catch per day for the vessel was highest in August with an average of 41 fish per day. The largest catch taken by trolling in any single day was 215 Spanish mackerel.

3.5 COMPARISON OF CATCH ETC. BY THE TWO FISHING METHODS

A comparison of results obtained by the two methods, gillnetting and trolling, is summarised in Table 4.

The superiority in catch and catch per unit of effort by the trolling method is evident and is more clearly shown in the section on ratios of fish catch by number and weight by hour and day.

4 BIOLOGICAL DATA

4.1 MACKEREL SAMPLE SIZE

A total of 1662 Spanish mackerel *(Scomberomorus commerson)* was taken during the survey, of which 1598 caught with troll lines and 64 caught in the gillnet.

The FL (length from tip of the snout to the caudal fork) of 1435 Spanish mackerel was measured, 657 were weighed and the gonads of 628 were examined.

4.2 MACKEREL LENGTH FREQUENCIES

The length frequency distribution of all Spanish mackerel measured is shown in Figure 4. The LCF's ranged from 56cm to 145 cm with major modes at 92cm and 109cm. Almost 80% of fish taken occured within the length range of 90cm to 119cm.

Separate graphs of the frequency distributions of LCF for male and female fish are also given (Figure 4). The females ranged in size from 60cm to 148cm while the males ranged from 54cm to 130cm. Approximately 25% of the female fish caught were larger than 114cm while only 6% of males exceeded that length.

The fish sampled showed no variation in LCF frequency distribution with geographic area.

4.3 MACKEREL WEIGHTS

The average weight of all Spanish mackerel caught by trolling was 9.0kg. The weights ranged from 1.5kg to 27.5kg although 80% of the fish caught were between 6 and 13kg.

4.4 MACKEREL LENGTH/WEIGHT RELATIONSHIP

The length/weight relationship for Spanish mackerel caught during the programme is shown in Figure 5. There was no significant difference in length/weight relationship between sexes throughout the areas fished. (Three areas were chosen for comparison: Area 1 - west of 116°00'E: Area 2 - 116°00'E to 121°00'E: Area 3 - East of 121°00'E).

4.5 SEX RATIO AND GONAD DEVELOPMENT

The sex ratio of the Spanish mackerel population sampled was 0.87 females : 1 male, although the ratios in different schools fished, varied from 0.33 females : 1 male to 3.45 females : 1 male.

The gonads of sampled fish were categorised into seven stages of sexual maturity ranging from stage 1 (immature) to stage 6 (running ripe) and stage 7 (spent). The frequency of occurrence of each sexual maturity stage is given in Table 5. Just under 90% of females were estimated to be less sexually mature than stage 4. (A. Church et. al. 1981, reported that highest catch rates of Spanish mackerel in Northern Territory waters were obtained in those areas where most of the female mackerel were at stage 4 or 5).

Gonad development was also determined by calculating the Gonad Index (Kikawa, 1953; Schaefer and Orange, 1954) using the formula:

$$G.I. = \frac{\text{Gonad Weight (gm)}}{\text{L.C.F. (cm)}^3} \times 10^4$$

and this relationship is shown in Figure 6 for 293 females examined.

The gonad index was calculated for fish samples at four different localities over the four month period of the survey (Figure 7). No difference appeared in the state of sexual maturity of the fish caught in different areas. Furthermore, practically no difference was detected between fish caught in July and those caught one month later (Figure 8).

The frequency distributions of gonad indices in different length categories were calculated (Table 6). Fish of lengths greater than 99cm LCF, appeared to be more sexually advanced (modal G.I. = .6 to .699) than fish below 99cm in length (modal G.I. = .4 to .499).

4.6 MACKEREL CATCH RATES AND WATER TEMPERATURE

Spanish mackerel were caught in surface waters ranging in temperature from 21.5°C to 27.4°C. Catch rates (fish/hour trolled) related to surface temperatures are shown in Figure 9, where the highest catch rates are shown to have been obtained in the range 22°-24°C.

Cursory examination of catch rate distribution by area and month (Appendix A) suggests that the population, or at least some part of the Spanish mackerel population, migrates southwards during late spring, summer and autumn and northwards during the winter months.

This apparent pattern of migration closely parallels the southward and northward movement of the 22°-24°C surface isotherms during the year (Appendix B, Source: GOSSTCOMP. Sea Surface Temperature Charts, EQ090E and SH090E - modified).

The southern limit (ca. latitude 34°S) of the 22°C isotherm approximates closely the southernmost reported catch of Spanish mackerel at the Bouvard's Reef (33°S).

4.7 SHARKS

Of the sharks caught in the gillnet during the survey the species of commercial importance were the black tip shark of the genus *Carcharhinus*. These are small sharks, some of which were observed to be sexually mature at only 80cm in length (an 82cm female carried two 18cm embryos). Only those sharks between 60cm and 160cm were considered to be of commercial importance.

3 677kg of black tip shark were caught during the survey and biological measurements were made on 129 of the sharks which comprised this catch. Seventy of those sharks measured were females while 59 were males, (sex ratio of 1.19 females : 1 male). The average length of the sharks (tip of the snout to end of the dorsal lobe of the tail) was 106cm. The length frequency distribution is shown in Figure 10.

Tissue samples were taken from 30 black tip sharks selected to cover the size range in order that the mercury content of the tissue could be determined (Figure 11).

4.8 OTHER PELAGIC FISH

Although Spanish mackerel made up the bulk of the fish caught by trolling, wahoo and Queensland school mackerel as well as small numbers of trevally and barracuda were also caught (Table 7).

A total of 102 wahoo *(Acanthocybium solandri)*, were caught during the survey. Most of these (87 fish) were caught around Rankin Bank in early October. The fish caught ranged in size from 107cm (7.0kg) to 156cm (25.0kg) with a mean length of 125.2cm.

The sex ratio for wahoo was 2.75 females : 1 male. Eighty nine percent of the female wahoo examined were at sexual stage 2.

Frequency distributions of the LCF's of male and female wahoo are shown in Figure 12. The length/weight relationship is shown in Figure 13.

Over the period of the survey 109 Queensland school mackerel *(Scomberomorus queenslandicus)* were caught. These fish ranged in length from 48cm to 81cm but the majority of the fish caught measured between 50cm and 70cm and the mean LCF was 60.07cm (Figure 14). The fish weighed between 1.25kg and 2.5kg.

5 CONCLUSIONS

5.1 GILLNETTING

The results of catching Spanish mackerel by gillnet show that this method of fishing is not an economically viable one in the area investigated.

Two factors may have contributed to the poor catch results (64 mackerel in 49 sets of the net or 1.43kg per hour of net fishing time) -

(1) The fishing depth of the net precluded its use close to shallow "drop offs" where fish could be caught by trolling. By decreasing the depth of the net, fishing could have been carried out in shallower waters, but this procedure may still not have increased the catch.

(2) Strong tides (3 knots tidal flows were common) caused the net to move quickly over selected bottom features thereby reducing the effectiveness of the net over specific sites.

The net was suitable for catching sharks although these were not a prime target species. Analysis of muscle tissue, from a limited number of specimens caught, to determine mercury content, indicates that the potential for development of a market for this relatively abundant black tipped shark may face problems with health regulations; the most recent National Health and Medical Research Council recommendation is for mercury in the fish catch not to exceed a mean value of 0.5 mg/kg nor a maximum of 1.5 mg/kg in any individual fish.

5.2 TROLLING

Although the vessel was not specifically fitted out for trolling and none of the crew had any developed expertise in this method of fishing, as many as 215 fish per day were taken by trolling. Catch rates varied between areas and times of day but overall averaged 19 fish per day and could have been higher had more effort been expended where relatively large concentrations of mackerel had been located.

Comparison of catch (kg) per trolling hour, using six lines, with catch (kg) per net hour set shows that trolling was 14.4 times more effective than gillnetting with a net of the size used.

5.3 VESSEL

The large distances involved in moving between fishing grounds require a vessel fishing in this region to have long endurance, low fuel consumption and the capacity to hold the catch for at least several days in frozen condition.

A dual purpose vessel able to fish for reef fish when Spanish mackerel are scarce would enhance the chance of success of a fishing operation in these waters.

5.4 AREAS

Economically viable catches by trolling were limited to very specific areas but it is doubtful that high catch rates in these areas could be maintained for extended periods under heavy fishing pressure.

Exploitation of the resource on a commercial basis would require the tactic, of fishing a number of grounds for short periods, to be adopted.

Likely areas, other than those described as having good potential, and which did not produce mackerel during the survey, are around the Monte Bello Islands, Exmouth Gulf region, Bonaparte Archipelago and Holothuria Banks.

These areas could be expected to produce economic catches if fished at the appropriate time of the year in positions where known favourable topographic features occur, i.e. close to reefs, over banks and along "drop offs".

5.5 SEASON

Cyclonic weather, normally occurring from November to April, could disrupt fishing activities, and this is reflected in the reduced effort expended* in the small Western Australian fishery in the north west area.

It was suggested, from results gained from the Northern Territory Mackerel Fishing Programme 1980/81, that "catches of Spanish mackerel may be most successful if troll-fishing is undertaken during the period when the fish have gonads developed beyond (stage 4)". Examination of the results, gained from the survey given in this report, of female mackerel gonad development, as well as the seasonal catch rates shown in Appendix A does not support this suggestion. Highest catch rates off the north west coast are made during the winter months, i.e. when the gonads, for the most part are in a resting state (i.e. stage 2).

6 DISPOSAL OF THE CATCH

Under the terms of the charter the primary sale of product was the responsibility of the vessel owner, but moneys from sales were paid into the joint account of the Commonwealth and State Governments.

Further, the costs of servicing the research programme were made a charge against the account funds provided for the survey and were set against the earnings from the sale of product.

The processed frozen catch, in bags, was road freighted from the ports of Broome, Port Hedland and Dampier to Perth where the primary sale of mackerel and other species was effected to W. Angliss and Co (Australia).

ITEM	WEIGHT (kg)	PRICE $/kg	VALUE ($)
Mackerel			
Trunks (i)	11170.26	1.80	20 107.26
Trunks (ii)	766.00	1.82	1 394.12
Fillets	40.00	2.10	84.00
Heads (for bait)	993.50	0.20	198.70
Others	1584.07	0.83(av)	1 310.66
		TOTAL	23 094.74

*Data on catch and effort statistics in Department's file.

7 ACKNOWLEDGEMENTS

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9. TABLE 1 - GILLNETTING CATCH SUMMARY 1981

SET NO.	DATE	POSITION (GRID)	CATCH						TOTAL CATCH (kgs)
			SHARK	TUNA	MACKEREL	REEF FISH	KINGFISH	SAILFISH	
1	17/6	1428	(2) 10						10
2	19/6	1325	(14) 100	(1) 3					103
3	19/6	1325	(55) 400		(13) 60				460
4	20/6	1424	(17) 80		(2) 6				86
5	21/6	1424	(190) 1200		(2) 8				1208
6	21/6	1423	(2) $^{\varepsilon}10$						10
7	22/6	1421	(2) $^{\varepsilon}10$	$^{\varepsilon}3$					13
8	26/6	1622	100		(2) $^{\varepsilon}14$				114
9	26/6	1622	(2) $^{\varepsilon}10$		(1) $^{\varepsilon}7$				17
10	27/6	1621	(10) $^{\varepsilon}50$	(1) $^{\varepsilon}7$					57
11	27/6	1721							-
12	28/6	1720	70	(4) $^{\varepsilon}14$					84
13	28/6	1720	(19) $^{\varepsilon}95$	(13) $^{\varepsilon}52$		(33) $^{\varepsilon}66$			213
14	29/6	1720	(15) 75						75
15	20/6	1720	(5) $^{\varepsilon}25$	(15) $^{\varepsilon}45$					70
16	1/7	1919	(3) 50						50
17	4/7	1919	(13) 200	(1) $^{\varepsilon}3$	(12) 115				318
18	5/7	1918	(10) 100	(3) $^{\varepsilon}9$					109
19	11/7	2015	(9) 50	(2) $^{\varepsilon}6$					56
20	11/7	2015	(67) 358	(2) 8	(1) 5				381
21	12/7	2015							-
22	13/7	2016	(6) $^{\varepsilon}36$		(4) $^{\varepsilon}12$				48
23	13/7	2016		$^{\varepsilon}6$					6
24	14/7	2114	(2) $^{\varepsilon}7$	(5) $^{\varepsilon}10$	(1) $^{\varepsilon}3$				20
25	14/7	2114	(2) $^{\varepsilon}12$	(1) 4	(2) 14				30
26	15/7	2114	(3) $^{\varepsilon}20$						20
27	16/7	2213	(5) $^{\varepsilon}27$	(6) 18					45
28	16/7	2113	(2) 6						6
29	17/7	2115	(9) $^{\varepsilon}47$	(1) $^{\varepsilon}3$					50
30	18/7	2015	(1) $^{\varepsilon}6$						6
31	19/7	1916							-
32	23/7	2017	(4) $^{\varepsilon}12$						12
33	24/7	1919	(4) $^{\varepsilon}25$		(1) $^{\varepsilon}7$				32
34	29/7	1920			(2) $^{\varepsilon}20$				20
35	31/7	1622	(2) $^{\varepsilon}20$	(2) $^{\varepsilon}8$	(2) $^{\varepsilon}6$		(15) $^{\varepsilon}56$		90
36	6/8	1821	(1) $^{\varepsilon}10$	(1) $^{\varepsilon}4$	(1) $^{\varepsilon}3$		(27) $^{\varepsilon}203$		220
37	10/8	1622	(11) $^{\varepsilon}2$						2

../2

SET NO.	DATE	POSITION (GRID)	C A T C H						TOTAL CATCH (kgs)
			SHARK	TUNA	MACKEREL	REEF FISH	KINGFISH	SAILFISH	
38	19 8	1721	(2) $^{\varepsilon}$30						30
39	22 8	1821	(3) $^{\varepsilon}$2		(2) $^{\varepsilon}$4				6
40	23 8	1920							-
41	30 8	1915		(1) 4	(1) 7	(2) 5			16
42	19 9	1918	(160) 312		(9) $^{\varepsilon}$36	(4) 12			360
43	22 9	2016	(14) 40	(6) 30			(8) 40	(2) 40	150
44	23 9	2016		(18) $^{\varepsilon}$53	(1) $^{\varepsilon}$7	(20) $^{\varepsilon}$60			120
45	26 9	2115	(2) 2		(2) 4		(3) 12		18
46	27 9	2114		(1) 3					3
47	28 9	2114	(9) 18	(15) 45	(3) 18				81
48	3 10	2213	(1) 10	(2) 6					16
49	7 10	1915	(1) 3						3
			3650	344	(64) 356	143	311	40	4844

NOTES: Weights of fish are given as whole weights

( ) indicates number of fish in grids - 60 nm grids

ε indicates estimated weight

9. TABLE 2 - SPANISH MACKEREL - CATCH BY AREA (TROLLING)

GRID	NO. OF FISH	WT. (kg)	TOTAL LINE HOURS	NO. FISH LINE/HR	kgs LINE/HR
1325	2	19.8	29:00	0.07	0.68
1326	NIL	-	25:10	-	-
1327	NIL	-	15:20	-	-
1329	NIL	-	20:30	-	-
1421	NIL	-	23:16	-	-
1422	NIL	-	12:36	-	-
1423	NIL	-	18:20	-	-
1424	NIL	-	79:00	-	-
1425	NIL	-	42:00	-	-
1521	NIL	-	4:00	-	-
1523	5	23.0	92:20	0.05	0.25
1621	3	31.0	38:15	0.08	0.81
1622	248	2280.5	256:00	0.97	8.91
1720	NIL	-	8:30	-	-
1721	NIL	-	50:09	-	-
1722	40	348.4	151:44	0.26	2.30
1819	NIL	-	7:30	-	-
1820	NIL	-	19:30	-	-
1821	457	3652.5	434:00	1.05	8.41
1822	NIL	-	42:00	-	-
1915	111	1099.6	356:40	0.31	3.09
1916	213	1523.5	220:45	0.96	6.93
1917	NIL	-	27:00	-	-
1918	1	6.0	177:21	0.01	0.33
1919	496	5334.9	512:15	0.97	10.42
1920	5	37.2	182:10	0.03	0.20
1921	NIL	-	63:00	-	-
2014	NIL	-	40:00	-	-
2015	1	13.0	206:00	0.005	0.06
2016	15	105.5	231:15	0.06	0.46
2017	NIL	-	143:45	-	-
2018	NIL	-	80:15	-	-
2113	1	5.0	49:00	0.02	0.10
2114	NIL	-	449:30	-	-
2115	NIL	-	76:30	-	-
2213	NIL	-	59:30	-	-
TOTAL	1598	14484.9	4244:06	AV. 0.38	AV. 3.41

TABLE 3 - NARROW-BARRED SPANISH MACKEREL - TROLLED FISH - CATCH BY MONTH

MONTH	DATE	NO. OF HOOKS TROLLED	NO. OF FISH PRESENT	NO. OF FISH PER 100 TROLLED	WEIGHT (KGS) OF FISH TROLLED	AVERAGE WEIGHT PER FISH (KGS)	NO. OF LINES FISHED	TOTAL LINE HOURS FISHED	CATCH PER LINE PER HOUR OF FISH	NO. CAPT. FISHED PER MONTH	UNDERSIZE CATCH IN %
FEB.	1321	4.00	NIL	-	-	-	2	8:00	-		
	1328	3.00	NIL	-	-	-	2	7:40	-		
	1327	7.60	NIL	-	-	-	2	15:20	-		
	1329	10.10	NIL	-	-	-	2	20:30	-		
	1421	11.38	NIL	-	-	-	2	23:16	-		
	1422	6.18	NIL	-	-	-	2	12:36	-		
	1423	1.00	NIL	-	-	-	2	2:00	-		
	1424	11.30	NIL	-	-	-	2	23:00	-		
	1521	2.00	NIL	-	-	-	2	4:00	-		
	1523	3.00	NIL	-	-	-	2	6:00	-		
	1621	7.30	3	0.40	31.0	10.3	3	22:30	0.13		
	1622	4.50	1	0.21	9.0	9.0	3	14:30	0.07		
	1720	2.50	NIL	-	-	-	3	8:30	-		
	1721	7.23	NIL	-	-	-	3	22:09	-		
	1722	2.57	NIL	-	-	-	2	5:54	-		
	1819	2.30	NIL	-	-	-	3	7:30	-		
	1820	6.30	NIL	-	-	-	3	19:30			
TOTAL		95.41	4	0.04	40.0	10.0		222:55	0.02	12	0.31

9. TABLE 3 (CONT'D) NARROW-BARRED SPANISH MACKEREL - TROLLED FISH

MONTH	GRID REFERENCE	NO OF HRS/MINS TROLLED	NO OF FISH TROLLED	NO OF FISH PER HR TROLLED	WEIGHT (kgs) OF FISH TROLLED	AVERAGE WEIGHT PER FISH (kgs)	NO OF LINES FISHED	TOTAL LINE HOURS FISHED	CATCH PER LINE PER HOUR (NO FISH)	NO DAYS FISHED PER MONTH	AVERAGE CATCH/ DAY NOS
July	1622	7.00	27	3.86	237.5	8.80	7	49:00	0.55		
	1722	5.00	4	0.80	24.0	6.00	7	35:00	0.11		
	1821	5.30	34	6.18	350.9	10.32	7	38:30	0.88		
	1915	2.00	NIL	-	-	-	3	6:00	-		
	1916	2.15	NIL	-	-	-	3	6:45	-		
	1917	2.00	NIL	-	-	-	3	6:00	-		
	1918	15.57	NIL	-	-	-	3	47:51	-		
	1919	53.00	377	7.11	4078.7	10.82	5	265:00	1.42		
	1920	7.00	3	0.43	25.1	8.37	7	49:00	0.06		
	1921	5.30	NIL	-	-	-	7	38:30	-		
	2015	16.45	1	0.06	13.0	13.00	3	50:15	0.02		
	2016	13.10	3	0.23	14.5	4.80	3	39:30	0.08		
	2017	1.45	NIL	-	-	-	3	5:15	-		
	2018	12.25	NIL	-	-	-	3	37:15	-		
	2113	3.00	1	0.33	5.0	5.00	3	9:00	0.11		
	2114	14.30	NIL	-	-	-	3	43:30	-		
	2115	15.00	NIL	-	-	-	3	45:00	-		
	2116	1.00	NIL	-	-	-	3	4:00	-		
TOTAL		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]

9. TABLE 3 (CONT'D) NARROW-BARRED SPANISH MACKEREL - TROLLED FISH

MONTH	GRID REFERENCE	NO OF HRS/MINS TROLLED	NO OF FISH TROLLED	NO OF FISH PER HR TROLLED	WEIGHT (kgs) OF FISH TROLLED	AVERAGE WEIGHT PER FISH (kgs)	NO OF LINES FISHED	TOTAL LINE HOURS FISHED	CATCH PER LINE PER HOUR (NO FISH)	NO DAYS FISHED PER MONTH	AVERAGE CATCH/ DAY NOS
Aug.	1325	3.00	2	0.66	19.8	9.9	7	21:00	0.10		
	1326	2.30	NIL	-	-	-	7	17:30	-		
	1423	2.20	NIL	-	-	-	7	16:20	-		
	1424	8.00	NIL	-	-	-	7	56:00	-		
	1425	6.00	NIL	-	-	-	7	42:00	-		
	1523	12.20	5	0.41	23.0	4.6	7	86:20	0.06		
	1621	2.15	NIL	-	-	-	7	15:45	-		
	1622	27.30	220	8.00	2034.0	9.25	7	192:30	1.14		
	1721	4.00	NIL	-	-	-	7	28:00	-		
	1722	15.50	36	2.27	324.4	9.0	7	110:50	0.32		
	1821	56.30	423	7.49	3301.6	7.8	7	395:30	1.07		
	1822	6.00	NIL	-	-	-	7	42:00	-		
	1915	25.00	93	3.72	909.3	9.8	7	175:00	0.53		
	1916	19.30	210	10.77	1501.5	7.15	7	136:30	1.54		
	1917	3.00	NIL	-	-	-	7	21:00	-		
	1919	8.45	114	13.03	1197.6	10.5	7	61:15	1.86		
	1920	5.30	NIL	-	-	-	7	38:30	-		
	1921	3.30	NIL	-	-	-	7	24:30	-		
	2015	8.30	NIL	-	-	-	7	59:30	-		
	2016	5.00	NIL	-	-	-	7	35:00	-		
TOTAL		225.00	1103	4.90	9311.2	8.44		1575:00	0.70	23	40.85

9. TABLE 3 (CONT'D) NARROW-BARRED SPANISH MACKEREL - TROLLED FISH

MONTH	GRID REFERENCE	NO OF HRS/MINS TROLLED	NO OF FISH TROLLED	NO OF FISH PER HR TROLLED	WEIGHT (kgs) OF FISH TROLLED	AVERAGE WEIGHT PER FISH (kgs)	NO OF LINES FISHED	TOTAL LINE HOURS FISHED	CATCH PER LINE PER HOUR (NO FISH)	NO DAYS FISHED PER MONTH	AVERAGE CATCH/ DAY NOS
Sep.	1918	8.30	NIL	-	-	-	7	59:30	-		
	1919	6.00	NIL	-	-	-	7	42:00	-		
	2015	13.45	NIL	-	-	-	7	96:15	-		
	2016	15.15	12	0.79	91.0	7.58	7	106:45	0.11		
	2017	9.30	NIL	-	-	-	7	66:30	-		
	2018	1.00	NIL	-	-	-	7	7:00	-		
	2114	24.00	NIL	-	-	-	9	216:00	-		
	2115	4.30	NIL	-	-	-	7	31:30	-		
TOTAL		82.30	12	0.15	91.0	7.58		625:30	0.02	14	0.86
Oct.	1915	17.34	18	1.02	190.3	10.57	10	175:40	0.10		
	1916	7.45	3	0.39	27.0	9.00	10	77:30	0.04		
	1918	8.45	1	0.11	6.0	6.00	8	70:00	0.01		
	1919	18.00	5	0.28	58.6	11.72	8	144:00	0.03		
	1920	11.50	2	0.174	12.1	6.05	8	94:40	0.02		
	2014	4.00	NIL	-	-	-	10	40:00	-		
	2016	5.00	NIL	-	-	-	10	50:00	-		
	2017	9.00	NIL	-	-	-	8	72:00	-		
	2018	4.30	NIL	-	-	-	8	36:00	-		
	2113	4.00	NIL	-	-	-	10	40:00	-		
	2114	19.00	NIL	-	-	-	10	190:00	-		
	2213	5.33	NIL	-	-	-	10	55:30	-		
TOTAL		114.57	29	0.25	294.0	10.14		1045:20	0.03	14	1.81
GRAND TOTAL		701.15	1598	2.28	14484.9	9.06		4244:06	0.38	85	18.80

9. TABLE 4 - SUMMARY AND COMPARISON OF CATCH EFFORT AND CATCH PER UNIT OF EFFORT FOR SPANISH MACKEREL BY GEAR TYPE

ITEM	GILL NET	TROLL LINE
Size of net	1390m x 15m	-
Number of troll lines	-	6
CATCH		
Number of Mackerel	64	1598
Total Weight (kg)	356	14485
Av. Weight of fish	5.56	9.06
EFFORT		
Number of days fished	49	85
Number of hours fished	248.58	701.25
Number of net sets	49	-
Av. Number of hours/set	5.07	-
Av. Number of hours/line/day	-	8.25
CATCH PER UNIT OF EFFORT		
Number of fish/set	1.31	-
Number of fish/day	1.31	18.81
Number of fish/hour	0.26	2.28
Number of fish/line/hour	-	0.38
Av. Weight (kg) of fish caught/set	7.27	-
Av. Weight (kg) of fish caught/day	7.27	170.41
Weight (kg) of Mackerel caught/hour	1.43	20.66
Weight (kg) of Mackerel caught/hour/line	-	3.44
RATIOS		
Number of fish/day	1	14.35 (6 lines)
Number of fish/hour	1	8.77 (6 lines)
Weight (kg) of fish/day	1	23.44 (6 lines)
Weight (kg) of fish/hour	1	14.45 (6 lines)
Weight (kg) of fish/day	1	3.91 (1 line)

9 TABLE 5 - GONAD STAGE FREQUENCY DISTRIBUTION BY SEX AND AVERAGE GONAD INDEX CALCULATED FOR EACH STAGE.

SEX	FEMALE							
SEX STAGE	1	2	3	4	5	6	7	TOTAL
No. in sample	0	175	81	23	6	0	8	293
%	0	59.7	27.6	7.8	2.0	0	2.7	99.8
Av. Gonad Index	-	0.486	0.607	0.862	0.920	-	0.591	

SEX	MALE							
SEX STAGE	1	2	3	4	5	6	7	TOTAL
No. in sample	0	52	38	73	112	52	8	335
%	0	15.5	11.3	21.8	33.4	15.5	2.4	99.9
Av. Gonad Index	-	0.179	0.250	0.242	0.295	0.395	0.257	

9. TABLE 6 - SPANISH MACKEREL

RELATIONSHIP BETWEEN LCF AND GONAD INDEX ($GI = \frac{GW(gm)}{LCF(cm)^3} \times 10^4$) DURING MONTHS JUNE JULY AND AUGUST 1981

SIZE GROUP	60-69		70-79		80-89		90-99		100-109		110-119		120-129		130-139		140-149			
G.I.	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	TOTAL	%
0-0.099	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	
.1-	-	-	1	34	3	1.02	3	1.02	1	.34	-	-	-	-	-	-	-	-	8	2.71
.2-	-	-	-	-	6	2.03	8	2.71	2	.68	2	.68	1	.34	-	-	-	-	19	6.44
.3-	1	.34	-	-	12	4.67	15	5.08	4	1.36	3	1.02	-	-	-	-	1	.34	36	12.20
.4-	-	-	-	-	9	3.05	25	8.47	15	5.08	5	1.69	-	-	1	.34	-	-	55	18.64
.5-	-	-	-	-	5	1.69	8	2.71	17	5.76	14	4.75	6	2.03	2	.68	1	.34	53	17.97
.6-	-	-	-	-	2	.68	9	3.05	17	5.76	22	7.46	6	2.03	1	.34	2	.68	59	20.00
.7-	-	-	-	-	2	.68	1	.34	5	1.69	10	3.39	5	1.69	3	1.02	-	-	26	8.81
.8-	-	-	1	.34	-	-	3	1.02	6	2.03	9	3.05	2	.68	1	.34	-	-	22	7.46
.9-	-	-	-	-	-	-	-	-	2	.68	-	-	2	.68	-	-	-	-	4	1.36
1.0-	-	-	-	-	-	-	-	-	1	.34	1	.34	-	-	1	.34	-	-	3	1.02
1.1-	-	-	-	-	-	-	-	-	-	-	2	.68	2	.68	-	-	-	-	4	1.36
1.2-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	
1.3-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	
1.4-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	.34	1	.34	2	0.68
1.5-	-	-	-	-	-	-	1	.34	-	-	1	.34	-	-	-	-	-	-	2	0.68
1.6-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	
1.7-	-	-	-	-	-	-	1	.34	-	-	-	-	-	-	-	-	-	-	1	0.34
2.80	-	-	-	-	-	-	1	.34	-	-	-	-	-	-	-	-	-	-	1	0.34
	1	.34	2	.68	39	13.22	75	25.42	70	23.73	69	23.39	24	8.14	10	3.39	5	1.69	295	100.00

9. TABLE 7 - FISH SPECIES OTHER THAN SPANISH MACKEREL TROLLED BY GRID SQUARE - 1981

	FAMILY													
	CARANGIDAE		*RACHYCENTRIDAE*	*SCOMBRIDAE*										*SPHYRAENIDAE*
GRID SQUARE	TREVALLY	QUEEN FISH	KING FISH	ORIENTAL BONITO	GREY MACKEREL	MACKEREL TUNA	NORTHERN BLUE FIN TUNA	QUEENSLAND SCHOOL MACKEREL	SHARK MACKEREL	SKIPJACK TUNA	SPOTTED MACKEREL	WAHOO	YELLOW FIN TUNA	BARRACUDA
1329		1												
1421						3						1	2	
1424								1			1			
1425											4			
1621						2	1				1			
1622	1		4		1	8	4	3	24		18			26
1720			1											
1721					3	2	2	4			5			
1722					1		2	2			1	1		
1821	99	5				1		56	23					3
1822							3							
1915			2				5		6			92	6	
1916						1		36	1			7		
1917				2		1								
1918						2	1							
1919	6				1	8								
1920						2	1	3						
1921						3	5							
2015	1					1								
2016						2		2			2			
2017							4							
2018						1		3						
2114				1				2	1	2				
2213												1		
TOTAL	107	6	7	3	6	37	28	112	55	2	32	102	8	29

TOTAL 534

SURVEY GILL NET

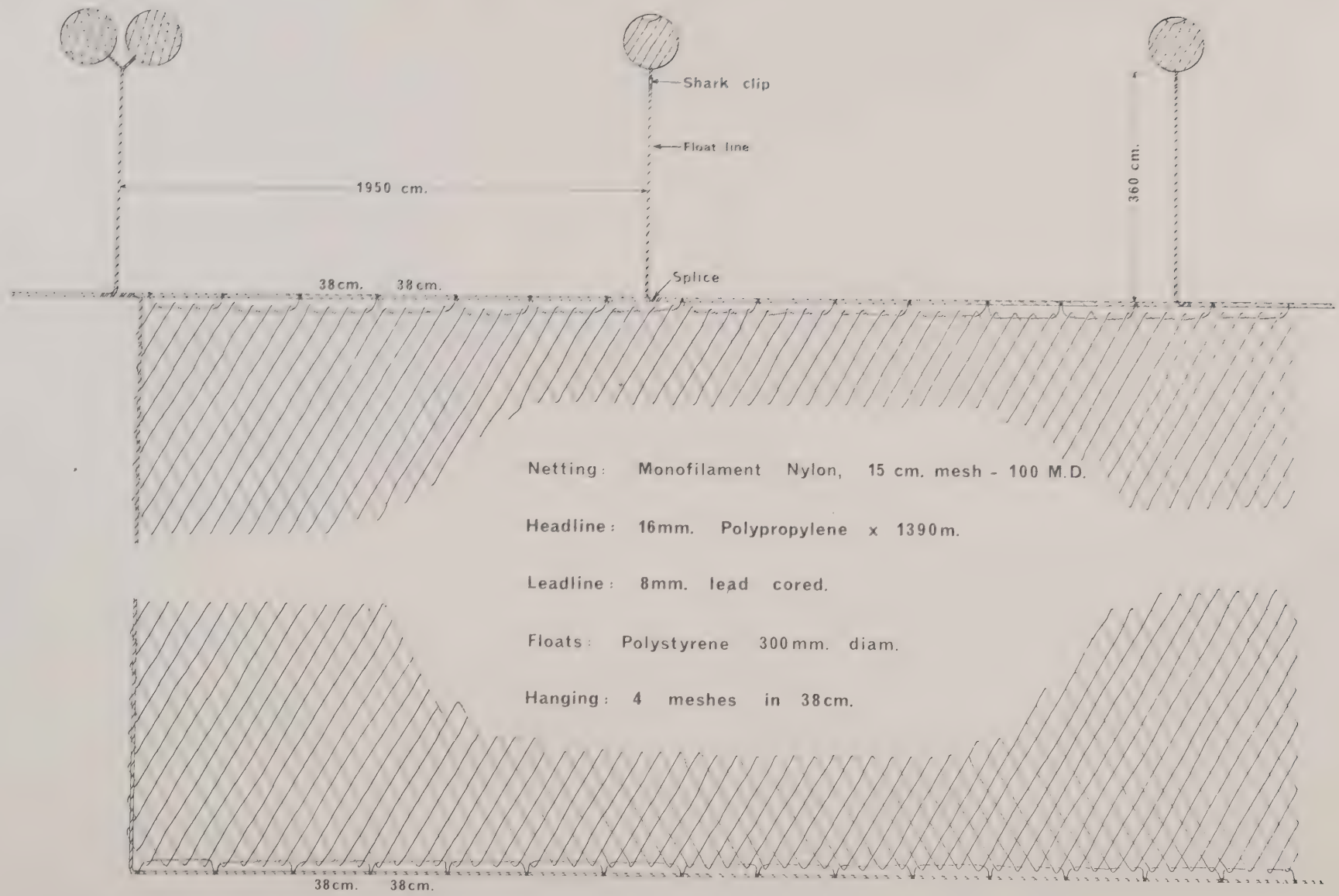


Fig. 1

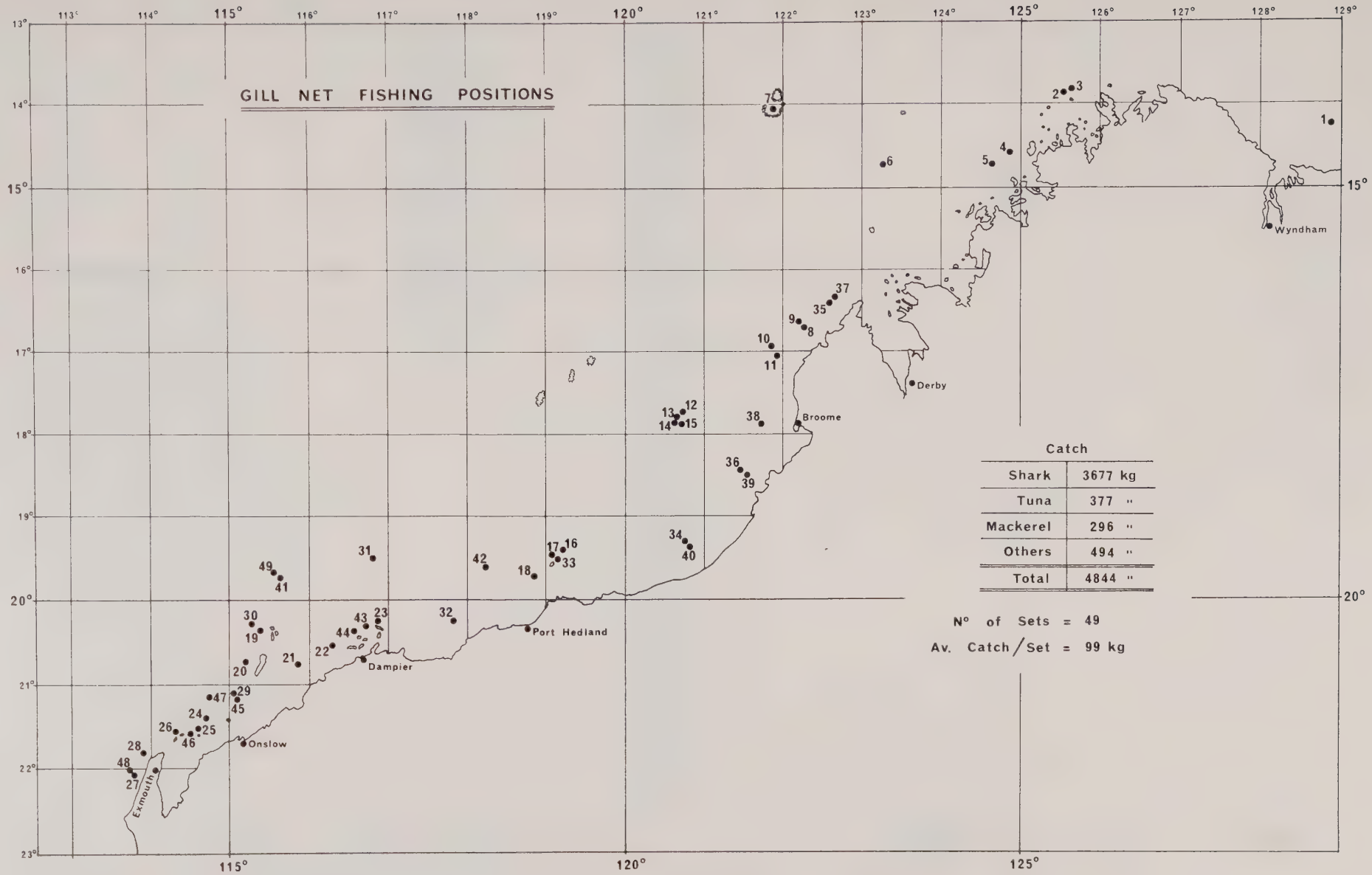

GILL NET FISHING POSITIONS
Wyndham
Derby
Broome
Port Hedland
Dampier
Onslow
Exmouth
Catch
Shark 3677 kg
Tuna 377 "
Mackerel 296 "
Others 494 "
Total 4844 "
Nº of Sets = 49
Av. Catch/Set = 99 kg

Fig. 2

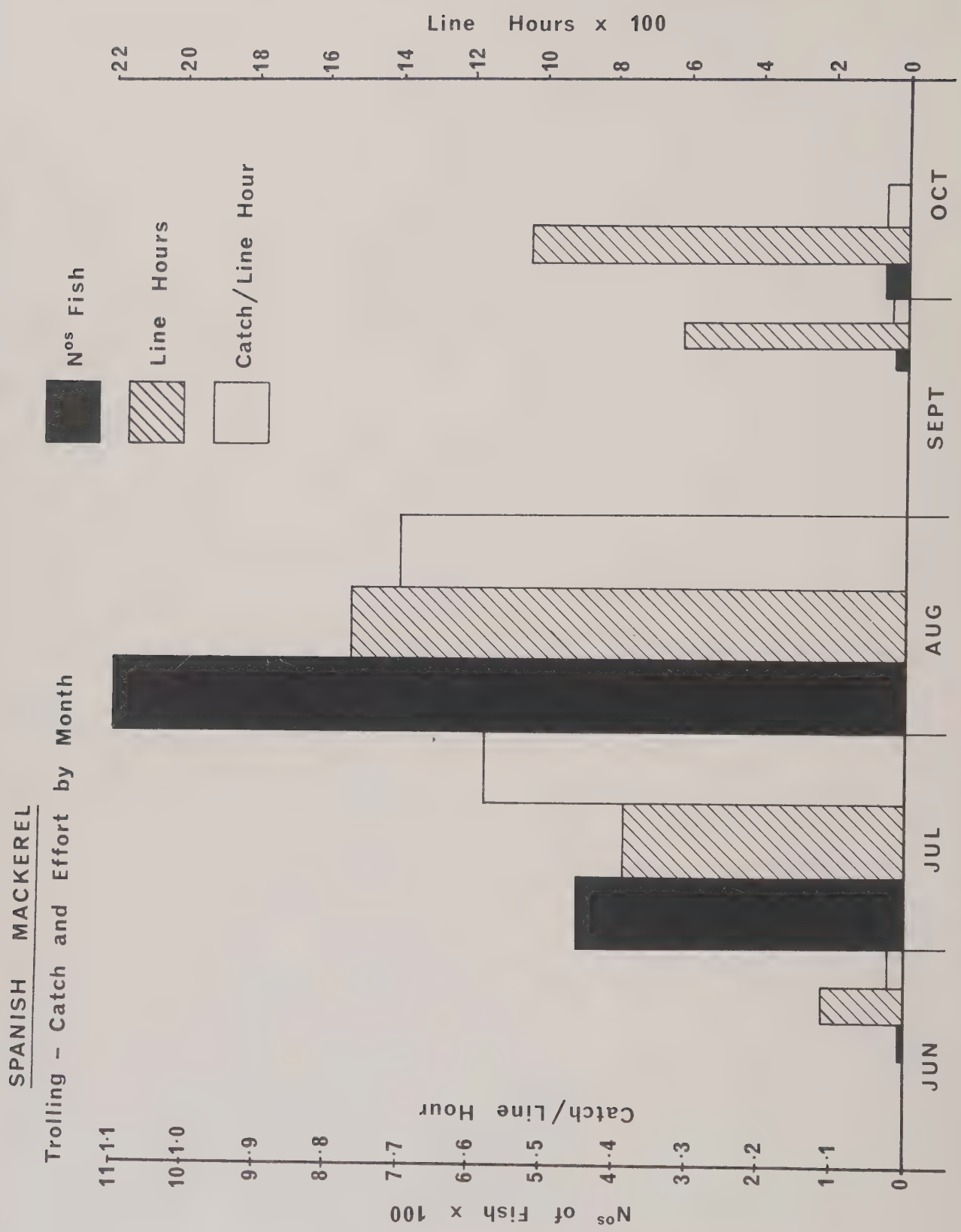

SPANISH MACKEREL
Trolling - Catch and Effort by Month
Nos Fish
Line Hours
Catch/Line Hour
Line Hours x 100
22
20
18
16
14
12
10
8
6
4
2
0
JUN
JUL
AUG
SEPT
OCT
Catch/Line Hour
11·1
10·1·0
9·9
8·8
7·7
6·6
5·5
4·4
3·3
2·2
1·1
0
Nos of Fish x 100

Fig. 3

SPANISH MACKEREL – LENGTH FREQUENCY DISTRIBUTION

(DATA SMOOTHED – AVERAGING BY 3's)

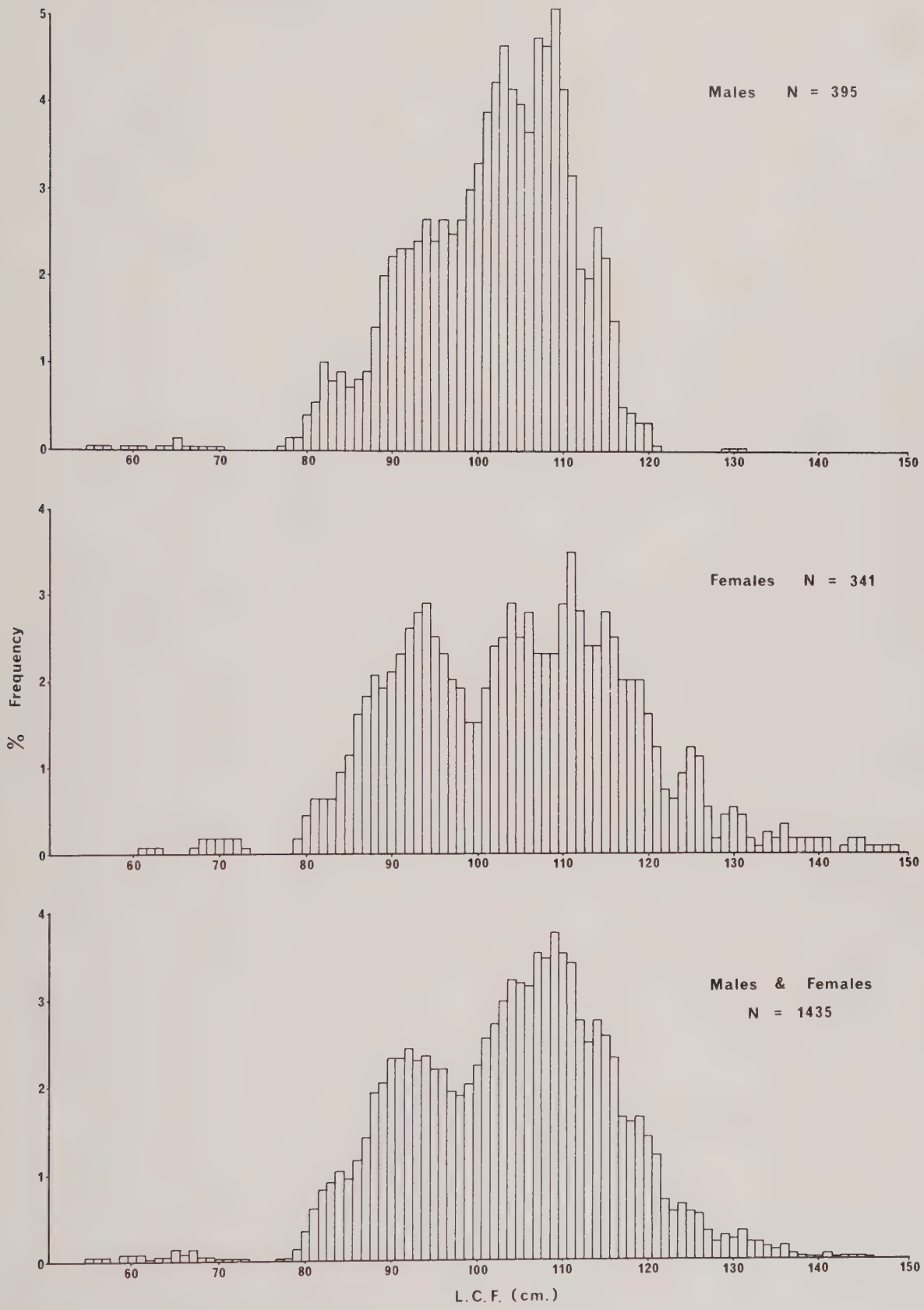


Fig. 4

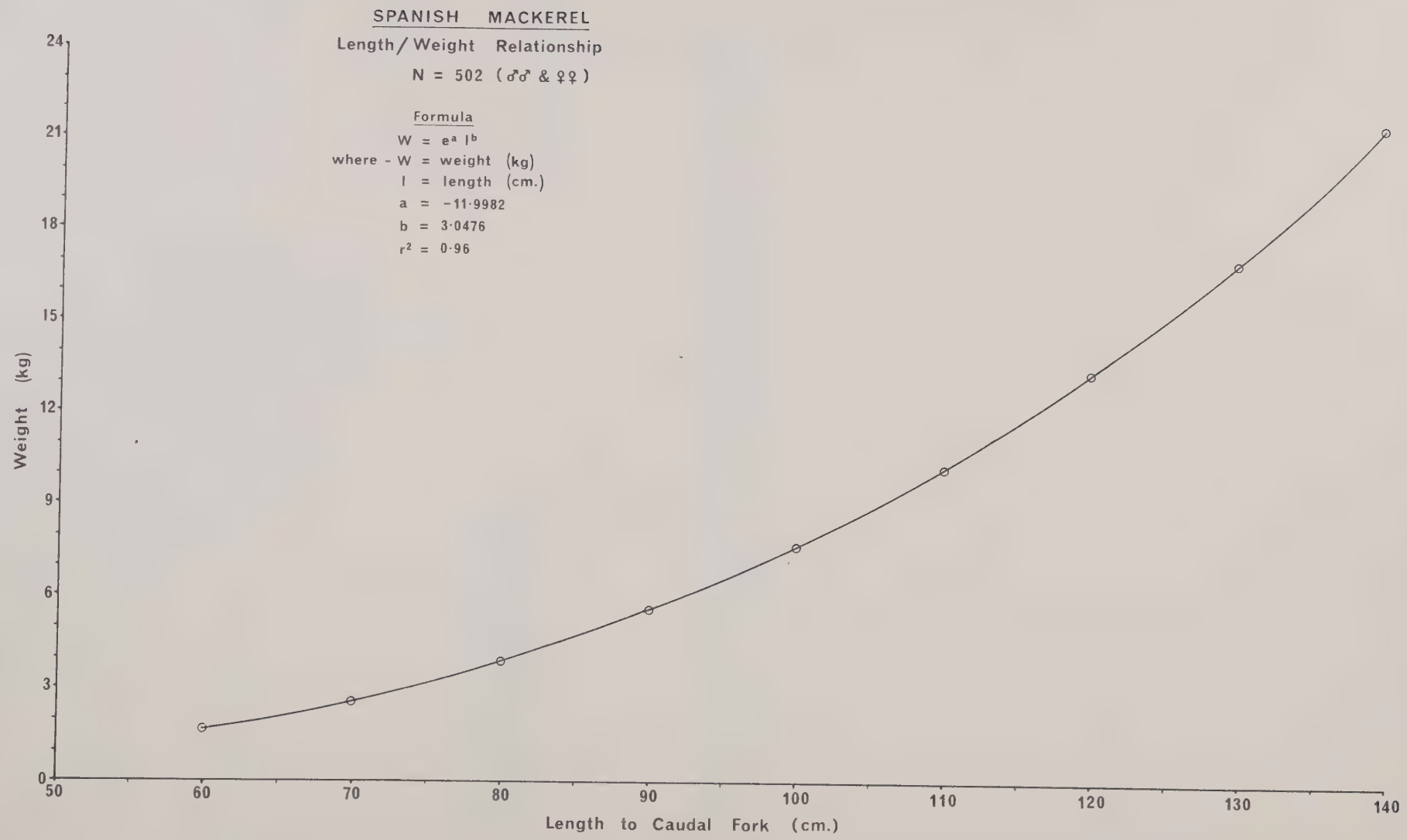

SPANISH MACKEREL
Length / Weight Relationship
N = 502 (♂♂ & ♀♀)
Formula
W = e^a l^b
where - W = weight (kg)
l = length (cm.)
a = -11·9982
b = 3·0476
r² = 0·96
Weight (kg)
0
3
6
9
12
15
18
21
24
50
60
70
80
90
100
110
120
130
140
Length to Caudal Fork (cm.)

Fig. 5

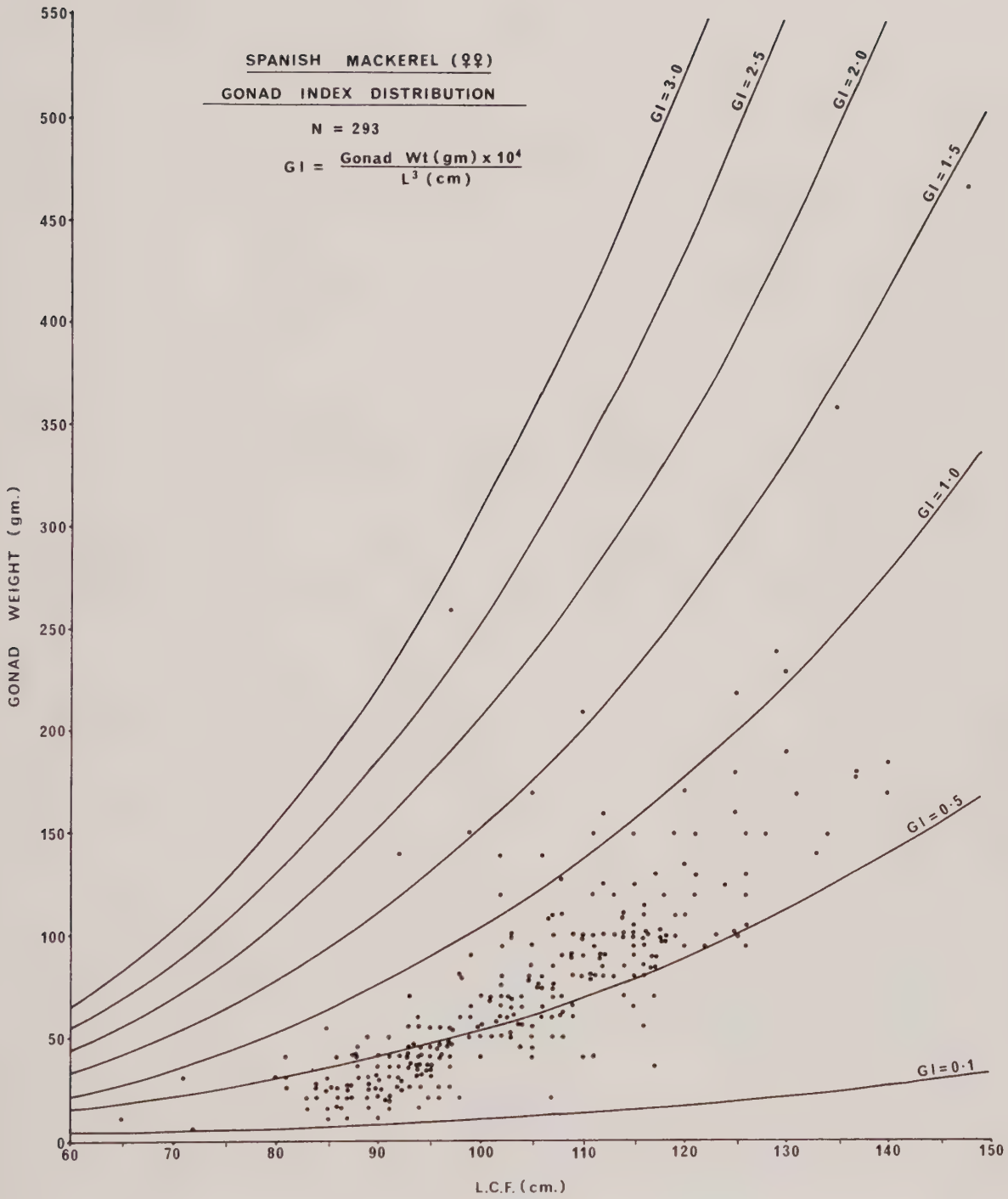

SPANISH MACKEREL (♀♀)
GONAD INDEX DISTRIBUTION
N = 293
GI = Gonad Wt (gm) x 10⁴ / L³ (cm)
GI = 3·0
GI = 2·5
GI = 2·0
GI = 1·5
GI = 1·0
GI = 0·5
GI = 0·1
GONAD WEIGHT (gm.)
L.C.F. (cm.)
0
50
100
150
200
250
300
350
400
450
500
550
60
70
80
90
100
110
120
130
140
150

Fig. 6

FREQUENCY DISTRIBUTION OF GONAD INDICES OF SPANISH MACKEREL BY AREA.

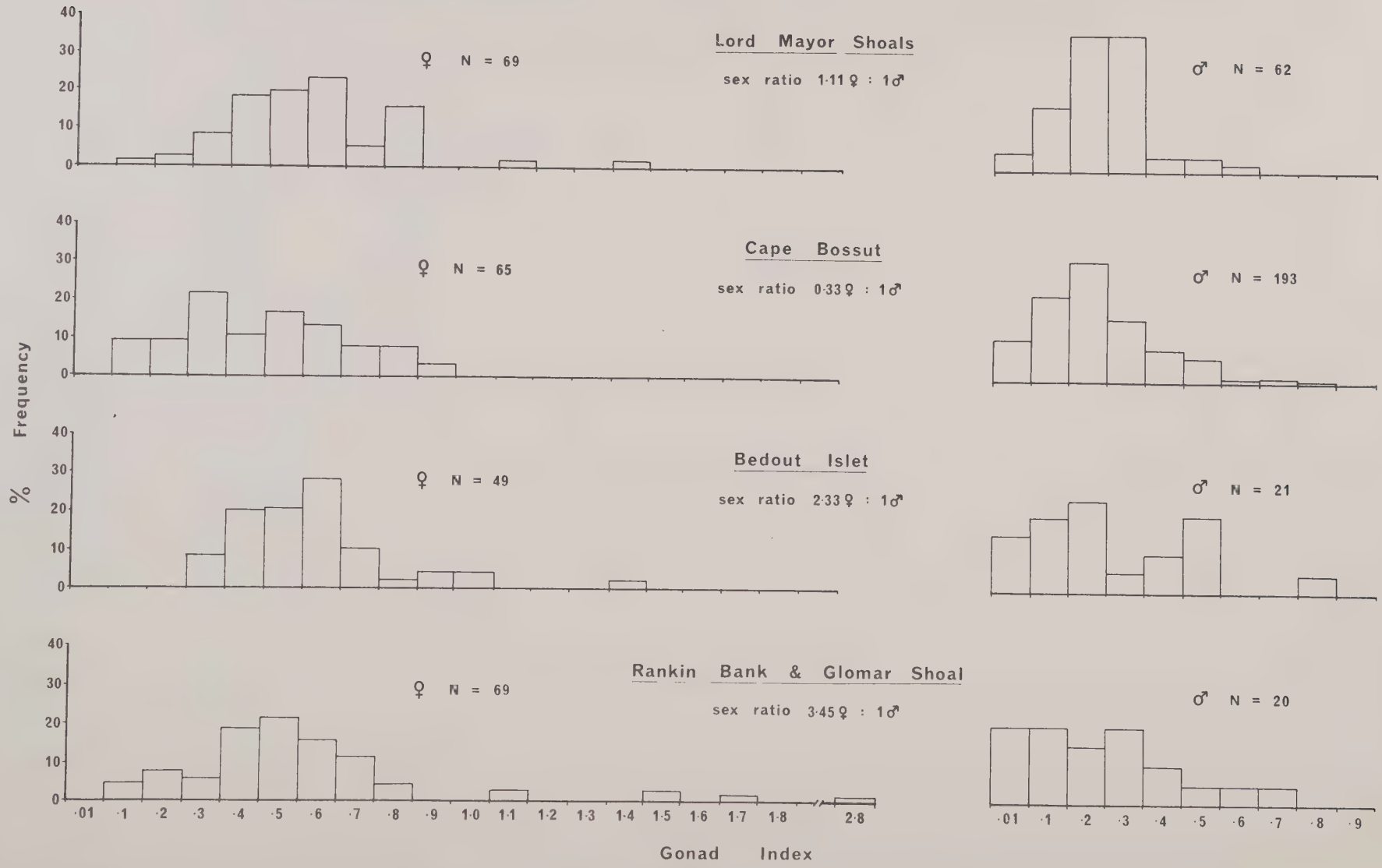


Fig. 7

COMPARISON OF FEMALE SPANISH MACKEREL GONAD INDEX FREQUENCY DISTRIBUTIONS FOR JULY AND AUGUST.

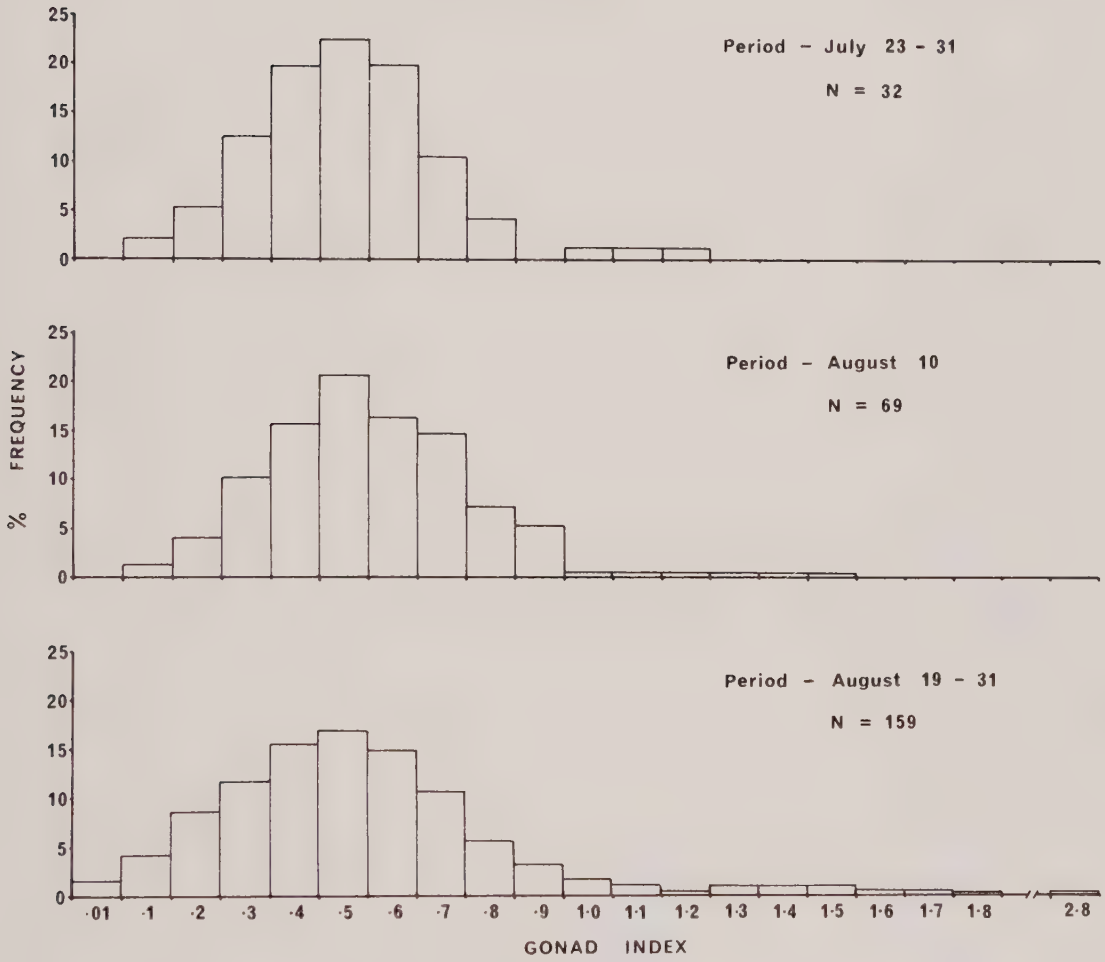


Fig. 8

SPANISH MACKEREL

RELATION BETWEEN CATCH RATE (BY TROLLING) AND SURFACE TEMPERATURE.

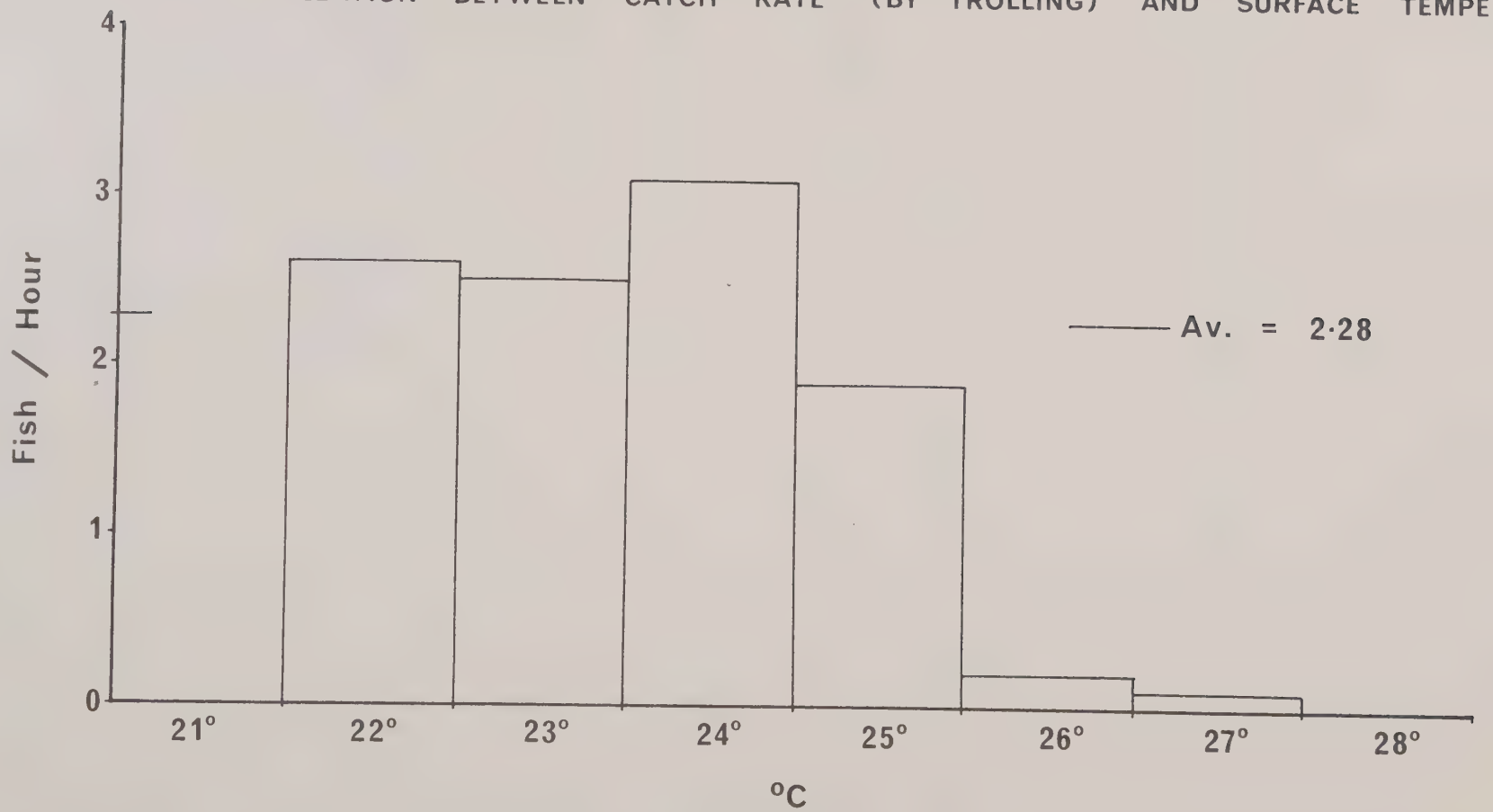


Fig. 9

BLACK TIP SHARK – LENGTH FREQUENCY DISTRIBUTION

(DATA SMOOTHED – AVERAGING BY 3'S)

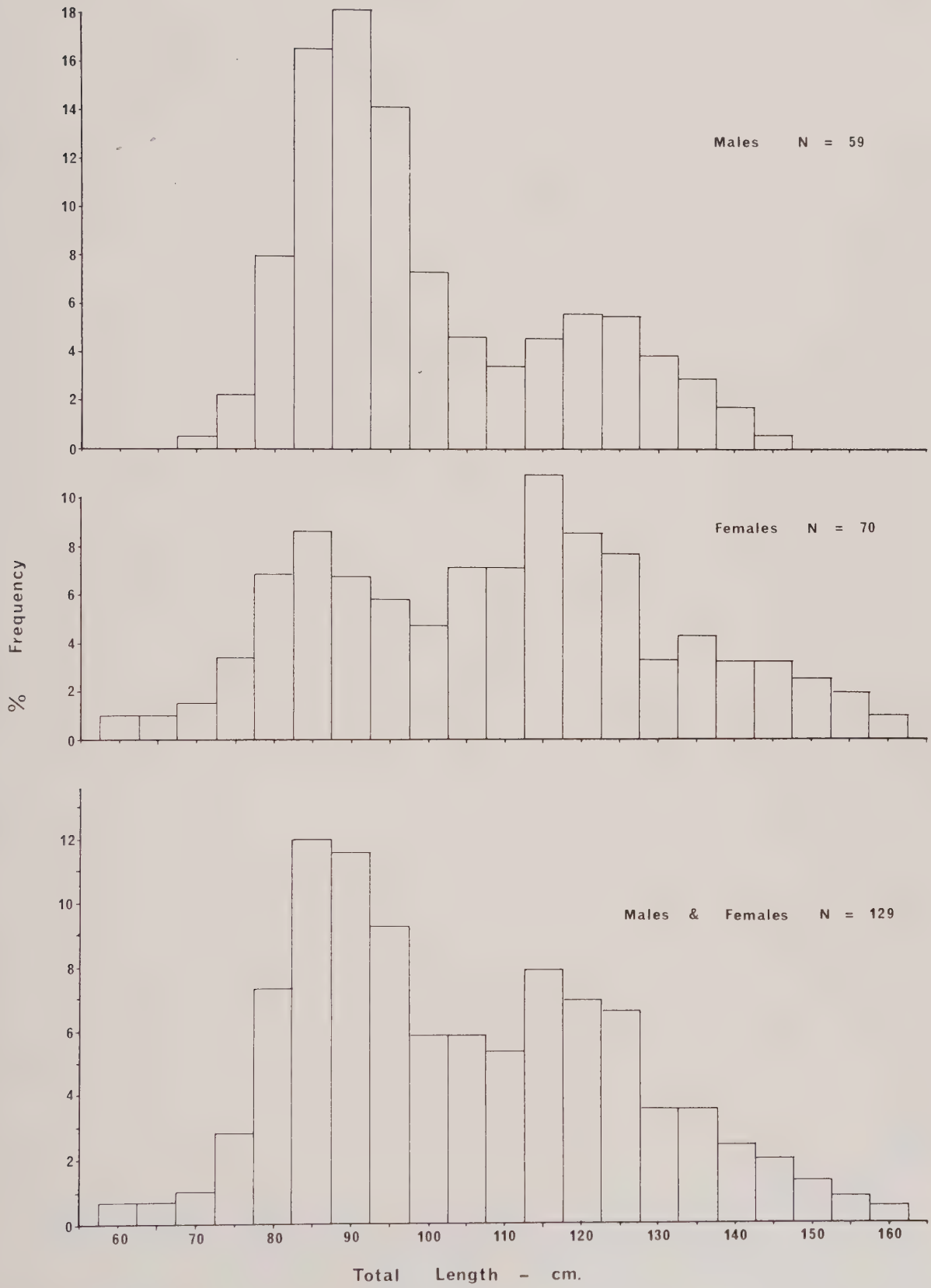


Fig. 10

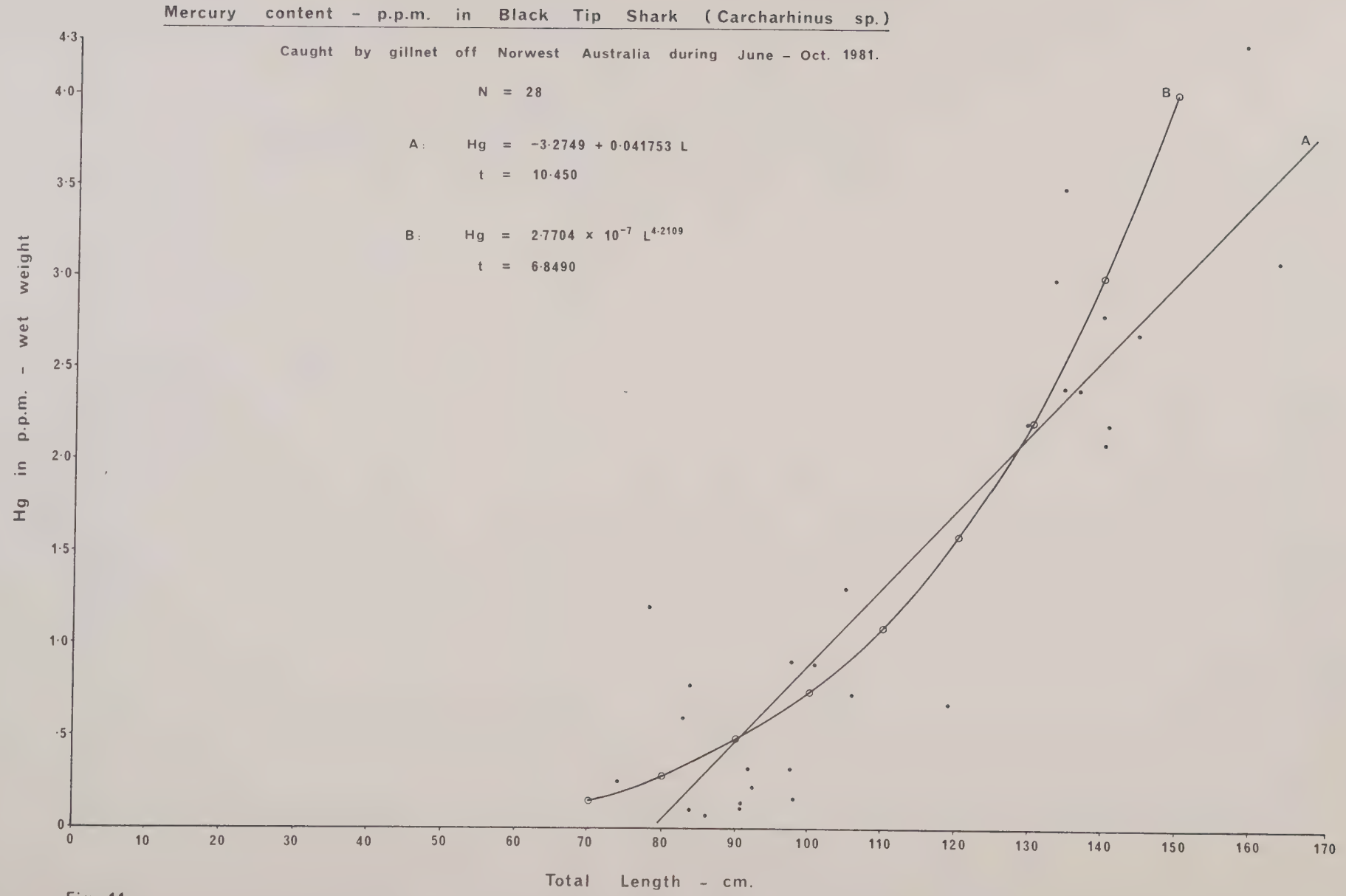

Mercury content - p.p.m. in Black Tip Shark (Carcharhinus sp.)
Caught by gillnet off Norwest Australia during June - Oct. 1981.
N = 28
A: Hg = -3·2749 + 0·041753 L
t = 10·450
B: Hg = 2·7704 x 10^-7 L^4·2109
t = 6·8490
Hg in p.p.m. - wet weight
Total Length - cm.
A
B
0
·5
1·0
1·5
2·0
2·5
3·0
3·5
4·0
4·3
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170

Fig. 11

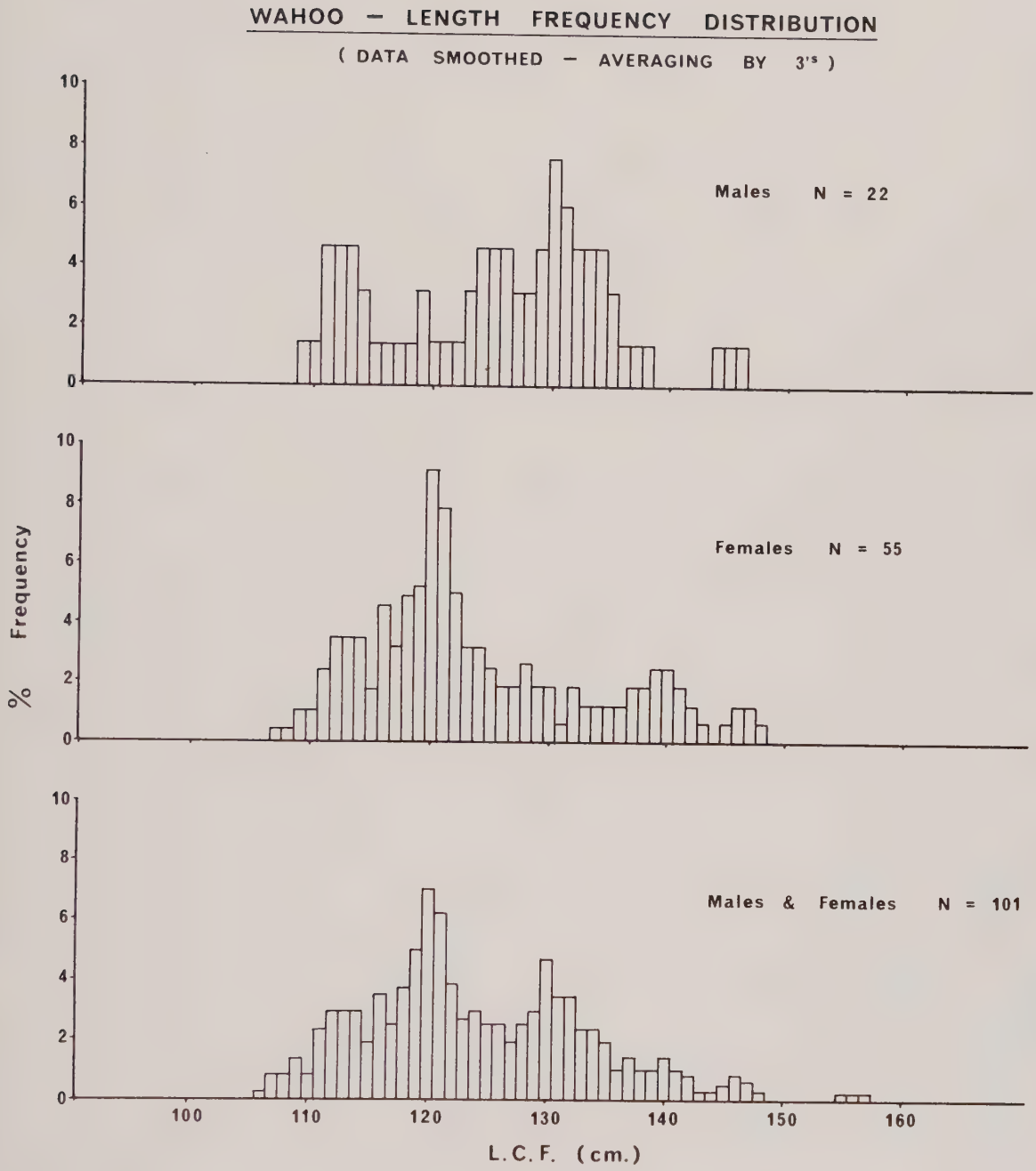

WAHOO – LENGTH FREQUENCY DISTRIBUTION
(DATA SMOOTHED – AVERAGING BY 3's)
Males N = 22
Females N = 55
Males & Females N = 101
% Frequency
0
2
4
6
8
10
100
110
120
130
140
150
160
L.C.F. (cm.)

Fig. 12

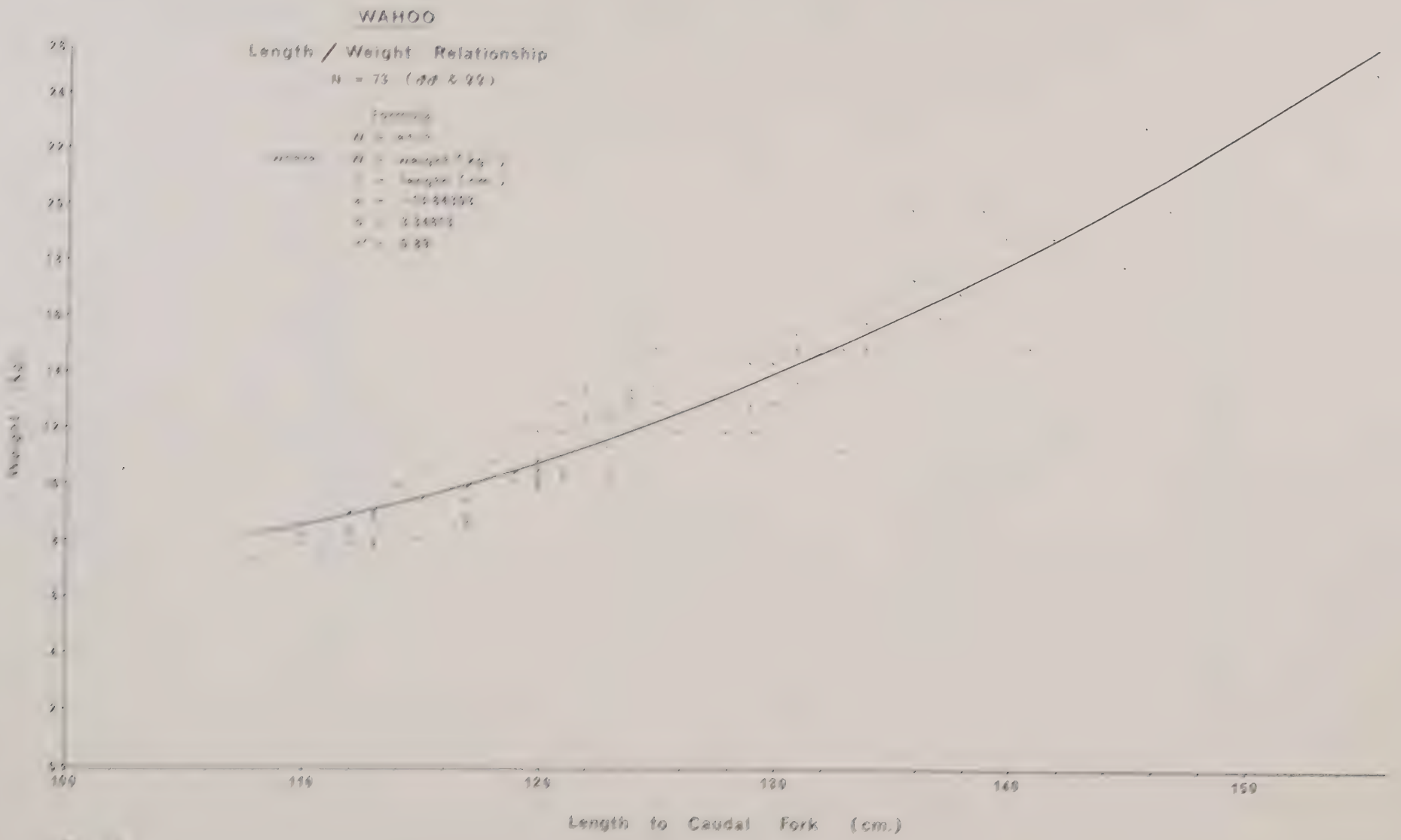

WAHOO
Length / Weight Relationship
N = 73 (♂♂ & ♀♀)
Length to Caudal Fork (cm.)

Fig. 15

QUEENSLAND SCHOOL MACKEREL - LENGTH FREQUENCY DISTRIBUTION

(DATA SMOOTHED – AVERAGING BY 3's)

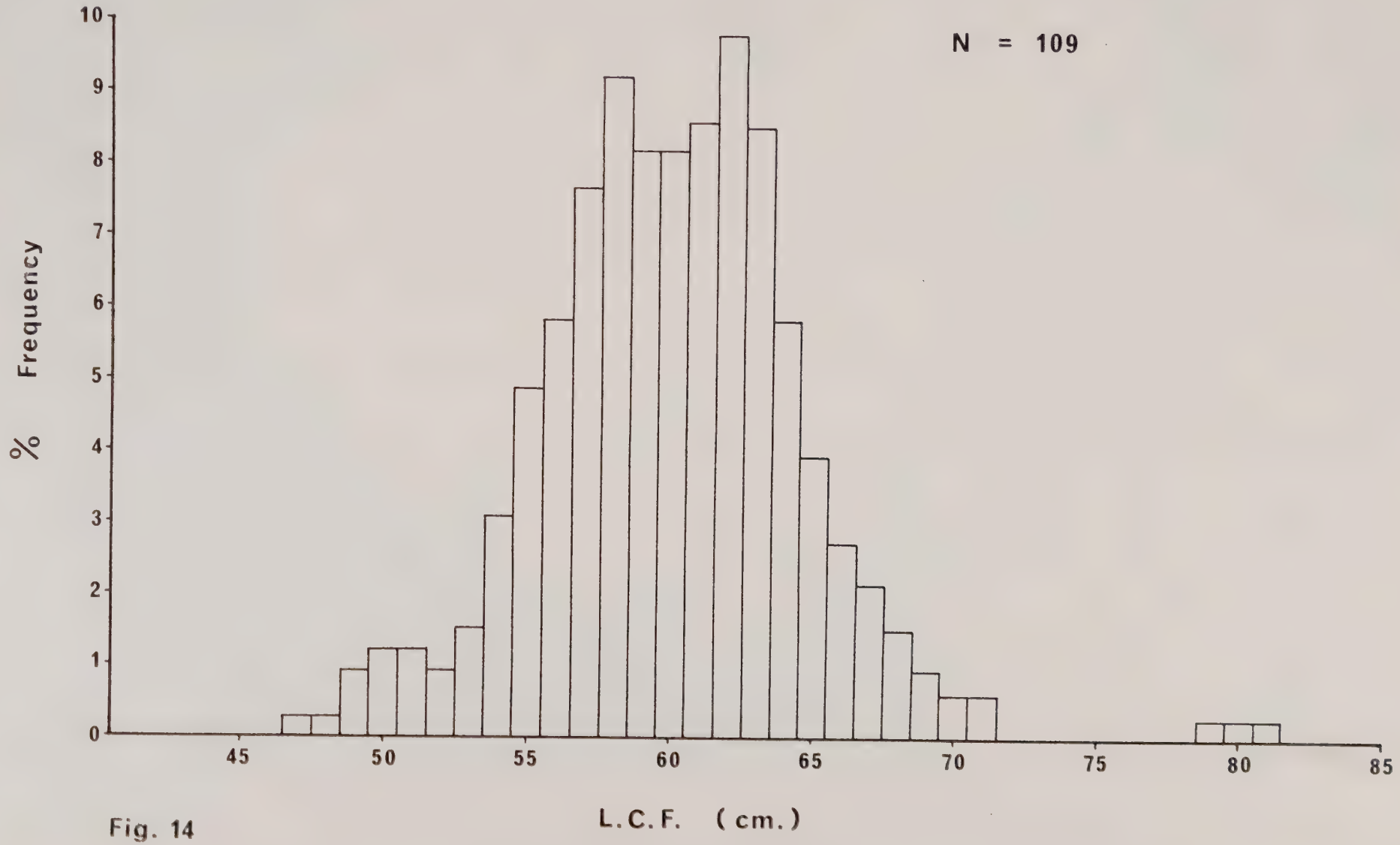
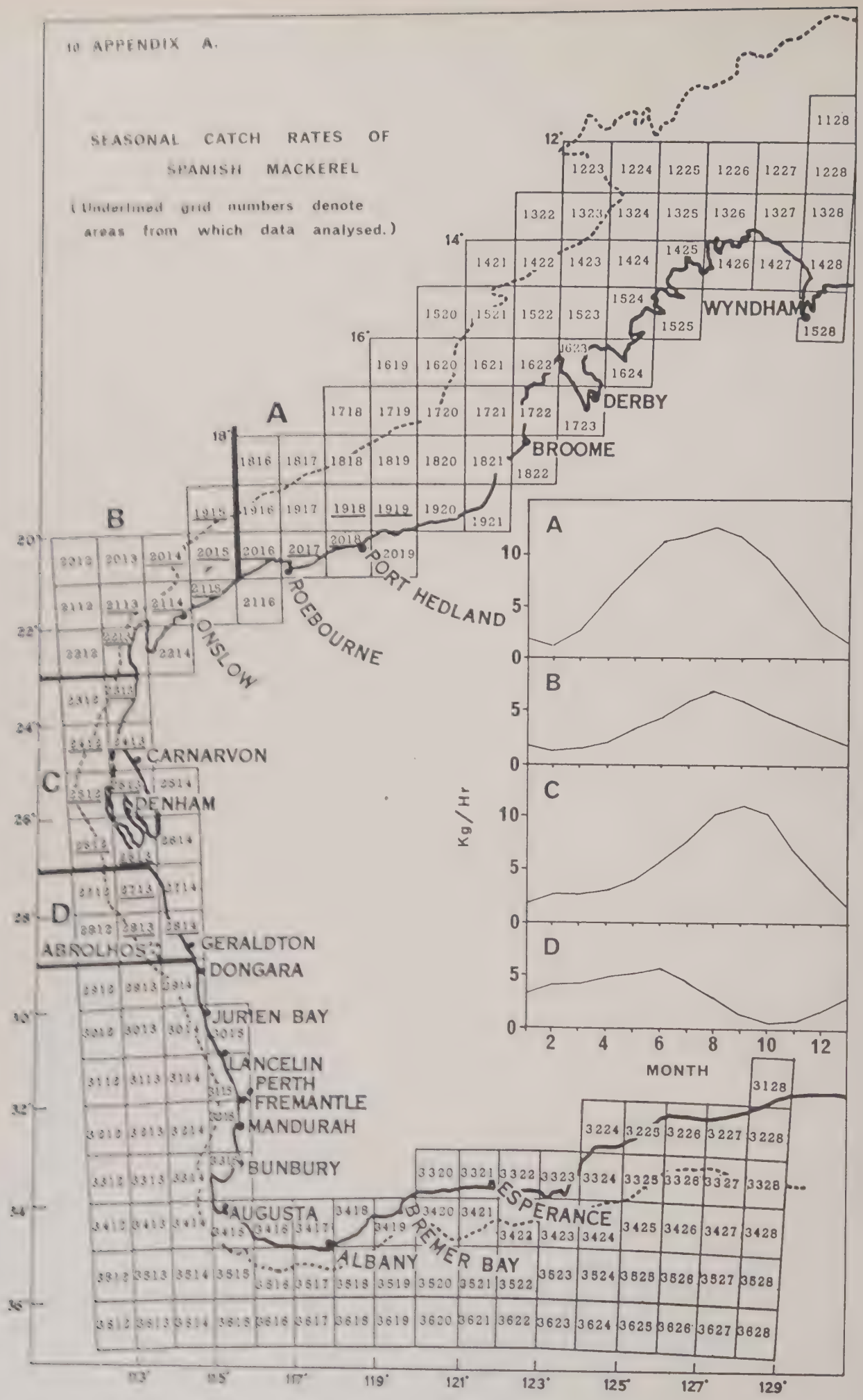


Fig. 14

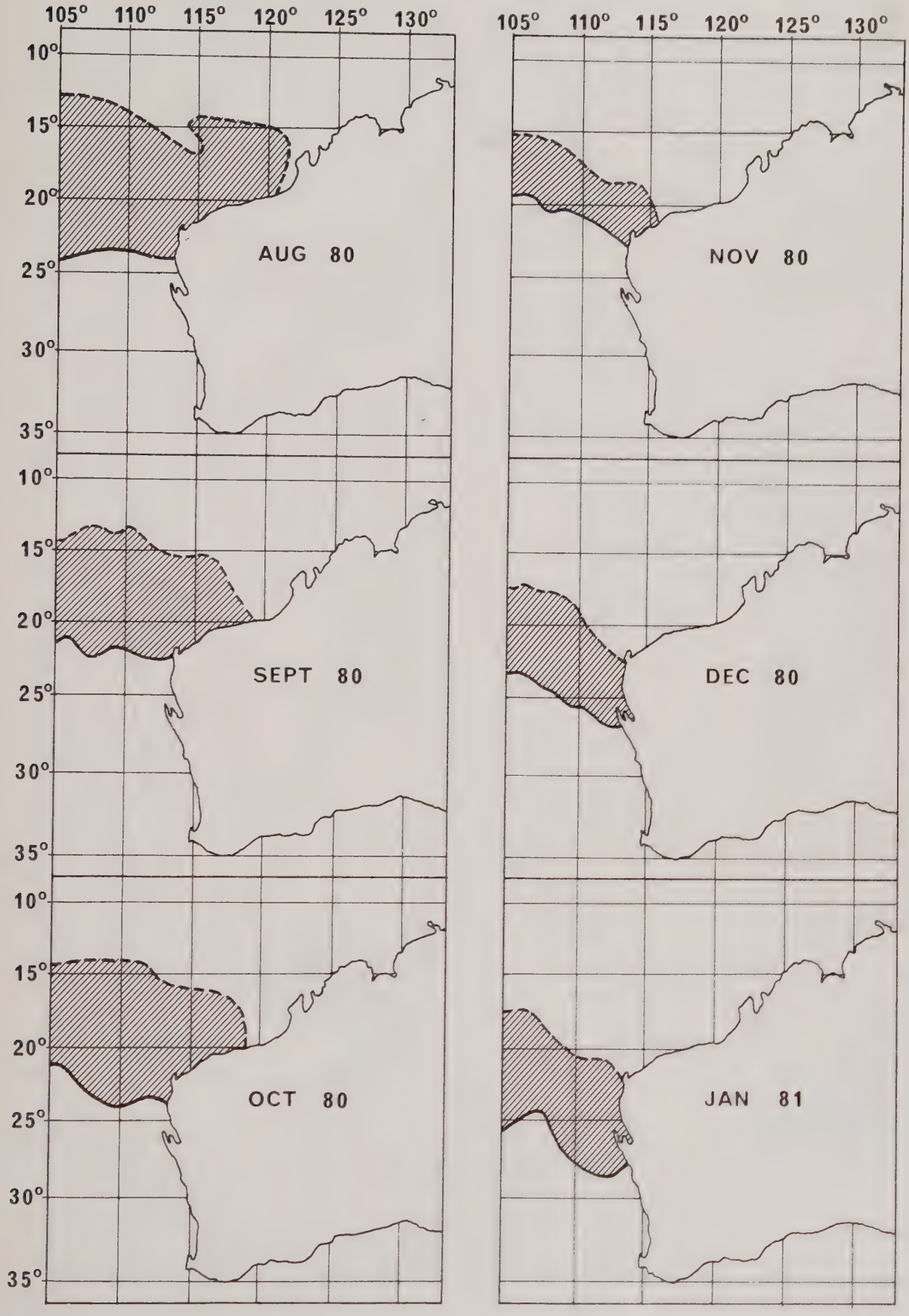
SEASONAL CATCH RATES OF SPANISH MACKEREL

(Underlined grid numbers denote areas from which data analysed.)

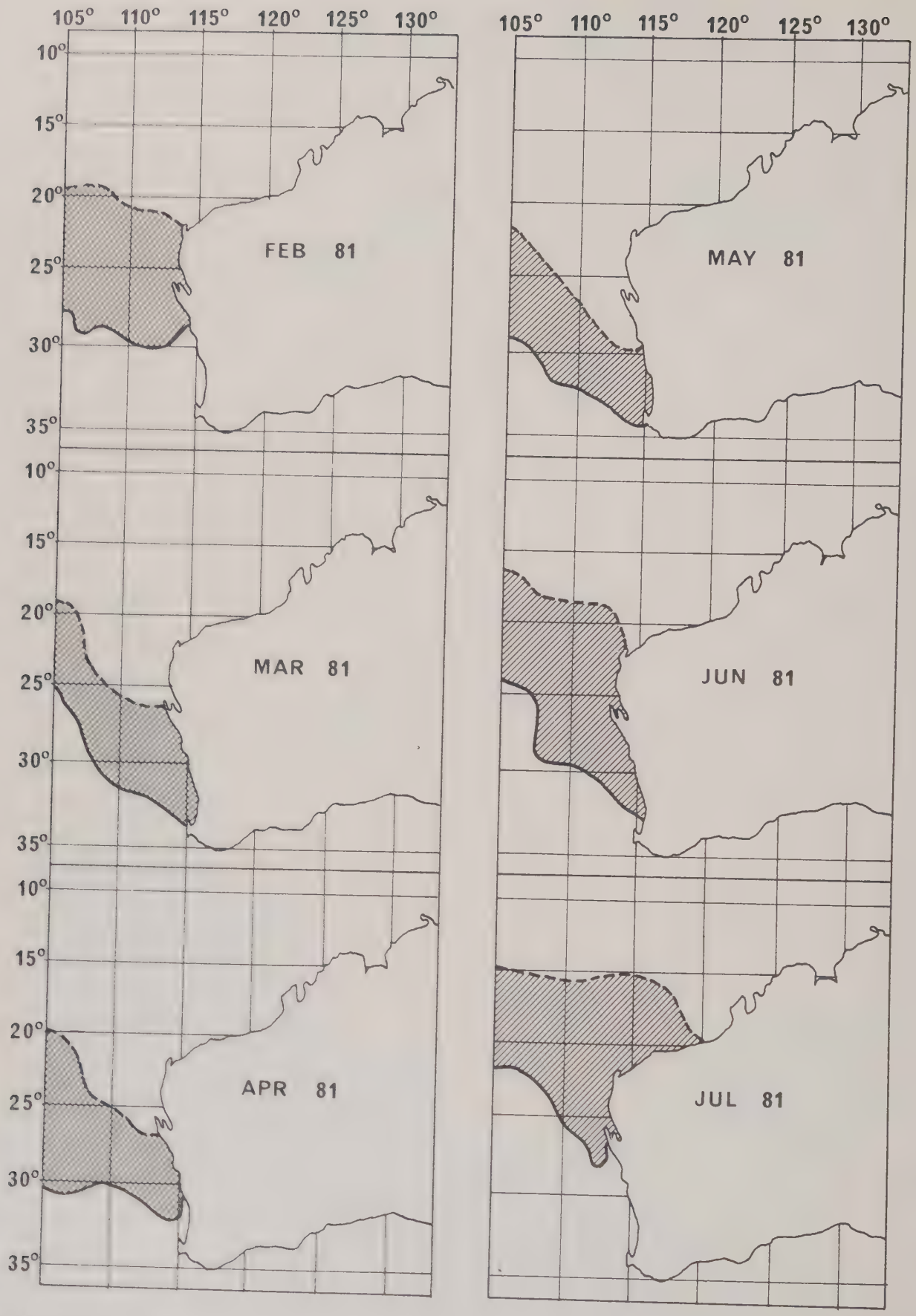


POSITIONS OF 22°C ———— AND 24°C - - - - - - ISOTHERMS

FOR PERIOD AUG'80 – JULY'81.



10. Appendix B.



10. Appendix B.

10. APPENDIX C - DETAIL OF FISHING OPERATIONS DURING MACKEREL GILLNETTING SURVEY

DATE 1981	DEPARTURE TIME	PORT	DATE 1981	ARRIVAL TIME	PORT	2. DAYS OUT	HOURS FISHING		REASONS FOR RETURN TO PORT
							TROLLING HRS:MINS	1. GILLNETTING HRS:MINS	
16/6	2045	Darwin	24/6	1600	Broome	9	70:31	29:50	Take on water
25/6	2130	Broome	6/7	1500	Pt Hedland	12	58:32	65:40	Take on stores, breakdown (alternator) and change personnel
10/7	1755	Pt Hedland	15/7	0810	Exmouth	6	38:55	38:43	Arrange for unloading catch and change of personnel
15/7	1800	Exmouth	20/7	1030	Pt Hedland	6	33:00	22:40	Take on stores, unload catch and change personnel
23/7	0615	Pt Hedland	3/8	0100	Broome	12	102:05	20:45	Take on stores, repair radar and change personnel
5/8	1640	Broome	5/8	1840	Broome	1	NIL	NIL	Repair radar
6/8	0900	Broome	7/8	1400	Broome	2	17:30	4:30	Repair radar and seek medical attention for crew
9/8	1430	Broome	15/8	1530	Broome	7	61:30	5:15	Seek medical attention for crew
16/8	0320	Broome	16/8	2000	Broome	1	11:30	NIL	Repair radar, pick up crew, take on stores and unload catch
19/8	1430	Broome	21/8	1530	Broome	3	22:00	4:05	Seek medical attention for crew
21/8	1730	Broome	25/8	0600	Pt Hedland	5	37:15	13:13	Repair radar
25/8	2000	Pt Hedland	1/9	1000	Dampier	8	64:45	4:30	Breakdown (hydraulic pump) and unload catch
18/9	1200	Dampier	20/9	1500	Pt Hedland	3	20:30	5:40	Take on stores and repair radar
21/9	0600	Pt Hedland	30/9	0930	Exmouth	10	58:15	23:35	Take on stores and change personnel
1/10	1045	Exmouth	9/10	0845	Dampier	9	65:52	10:10	Take on water
9/10	1300	Pt Hedland	14/10	1500	Pt Hedland	6	49:05	NIL	Unload catch, fishing gear and finish charter
					TOTALS	100	701:15	248:36	

1. Gillnetting time is from commencement of setting operation to end of hauling operation

2. A day out is given as any part of a day that the vessel was away from a port

10. APPENDIX D. DETAILS OF FISHING VESSEL, "RACHEL"

Length : 21.35 m
Beam : 6.7 m
Draft : 3.13 m
Construction : Steel
Date of Construction : 1975

Main Engine

Make : Kelvin TS8
No. of Cylinders : 8
R.P.M. : 1000
Power : 320 H.P.
Reduction Gear Ratio : 3:1

Auxiliaries

Make : Dorman LDZ Diesel
Power : 71 H.P.
AC/DC Voltages Available : 240 & 400 volts AC; 24 volts DC
Range of Vessel : 3500 nautical miles
Fuel Capacity : 13620 litres

Net Reels

Type of Drive : 2 x Raymond low pressure hydraulic
Power Available : 25 H.P.
Retrieving Rate : Variable metres/min
Reel Diameter : 1800 mm (both)
Reel Width : 1300 mm (both)

Fish Handling and Holding

Refrigeration :

(i) Blast Freezer : Twin Unit Kelvinator.
Capacity : 2000 kg. Throughput/24 hours - 2000 kg

(ii) Hold Capacity : 20000 kg
Holding Temperature : -30°c at least

(iii) Refrigerated Sea-water
Tank Capacity : 14000 kg, immersion

Echo Sounder

Make and Model : Furuno FUV 12, Bottom Expansion with Oscillograph and Universal Graph
Range : 500 fathoms
Frequency : 28 and 200 KHz

Other

Deck Lighting for Night Fishing :
5 x 1000 watt lights
5 x 500 watt lights
spot light in crow's nest
15' dinghy with outboard motor

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